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ABSTRACT

Classroom tested ideas and resources for social studies and science teachers on toxic and hazardous substances are provided in this guide. Suggestions are included for ways of increasing student awareness and knowledge about this problem. Although the materials were primarily developed for junior high students they can be adapted and modified for other grade levels and can be integrated into an established curriculum framework. An introductory section provides an explanation on how to use the guide and also identifies potential problems and implications for instruction of this complex and controversial topic. Other sections contain: (1) 27 instructional activities (ranging from simulations and experiments to surveys and computer games); (2) annotated lists of audio-visual aids (with sources indicated); (3) a chart showing contributions of projects to meeting standards of learning (identifying the ways in which the instructional activities correspond to the State of Virginia's expectations in its Standards of Learning); (4) appendices (presenting major toxic substances laws, a guide for hazardous materials disposal, and lists of resource personnel and organizations); and (5) glossary (with definitions related to toxic and hazardous substances). (ML)

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The Dilemma Of Toxic Materials

Classroom-Tested Ideas And Resources For Social Studies And Science Teachers

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1985
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Prologue

A Conservationist's Lament

The world is finite, resources are scarce,
Things are bad and will be worse,
Coal is burned and gas exploded,
Forests cut and soils eroded.
Wells are dry and air's polluted,
Dust is blowing, trees uprooted.
Oil is going, ores depleted,
Drains receive what is excreted.
Land is sinking, seas are rising,
Man is far too enterprising.
Fire will rage with Man to fan it,
Soon we'll have a plundered planet.
People breed like fertile rabbits,
People have disgusting habits.

Moral:
The evolutionary plan,
Went astray by evolving man.

The Technologist's Reply

Man's potential is quite terrific,
You can't go back to the Neolithic,
The cream is there for us to skim it,
Knowledge is power, and the sky's the limit.
Every mouth has hands to feed it,
Food is found when people need it.
All we need is found in granite,
Once we have the men to plan it.
Yeast and algae give us meat,
Soil is almost obsolete.
Men can grow to pastures greener,
Till all the earth is Pasadena.

Moral:
Man's nuisance, Man's a crackpot,
But only Man can hit the jackpot.

Anonymous

Foreword

During the last decade several significant disasters and potential disasters have highlighted the need for more insight about toxic substances and hazardous wastes. Terms such as kepone, Valley of the Drums, and Love Canal have connotations much more sinister than the chemicals and locations which they originally described. These and other such examples have made it apparent that the problems of toxic materials is a reality that must be faced as a result of our industrial/technological society.

There are many scientific and social decisions being made about toxic materials which can have tremendous impact upon the quality of life for individuals and communities. On the community level, in particular, the discussions accompanying these decisions are likely to involve those who have only passing knowledge about toxic substances and hazardous wastes. It is of great importance then that students, as future citizens, become better acquainted with various facets of this critical issue.

The educational materials contained herein suggest ways of increasing student awareness and knowledge about the problem and identify important issues and concepts that can be easily integrated into the established curriculum framework. This is a welcomed contribution to the environmental education effort.

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No publication of this scope about toxic substances would be possible without the help of many people. The authors have been fortunate in this respect. We began with the initiative and generous support of the Virginia Environmental Endowment. This support made it possible to tap the expertise of literally scores of individuals and organizations.

Unfortunately, there is no way to identify all who contributed to this effort. We would like, however, to acknowledge our particular gratitude to the following contributors:

For their help in innumerable and diverse ways: At the Virginia Environmental Endowment, Gerald P. McCarthy, Executive Director, and Betty Toler, Assistant Director. At Virginia Commonwealth University Dr. David Hartman, Assistant Dean, College of Humanities and Sciences, and Dr. John Oehler, Assistant Dean, School of Education.

For willingness to take time from busy schedules to share their knowledge and experiences in the field of toxic materials: Dr. Carl W. Armstrong, David Bailey, Dr. Morris Brehmer, Richard Cook, General J. A. Corder, Timothy Cotman, Terri Cross, Richard C. Dawson, Martin Ferguson, Dr. Cathy Harris, Timothy Hayes, Fire Chief Kenneth Lavoie, Sandra Morse, Sargent R. V. Quinley, Charles Ramsey, William Rosbe, Dr. Bernard Schneider, Barbara Spain, and William Walker. (For information about the affiliation of these contributors, please refer to Section VI.)

For their invaluable help with the development and classroom evaluation of the instructional activities: All of the participants in our three workshops who are listed in Section VI of this guide. One of the most difficult task we faced was selecting from the nearly 100 hundred worthy activities which were worked on and evaluated as part of the workshops. Many factors had to be considered during the selection process, which meant, unfortunately, that a number of excellent ideas could not be included.

For their special effort in helping with various aspects of this endeavor: Susan Booth, Jane Carroll, Gerald Evans II, Janet Hadley, William Hastings, Jr., Sally Jacobs, Don Marsh, II, Vickie Odell, Alice Washington, Janice Westbrook, and Elaine Woodard.

For her special attention to proofing the final version of the manuscript, Dr. Marijean Hawthorne.

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We also would like to thank the National Wildlife Federation and the Environmental Action Foundation for providing material that has been reproduced in this publication. These include many of the laws found in the Appendix and information about vermiculite.

A Note About Objectivity and Precautions

With our sincere gratitude expressed, we hasten to absolve these and other contributors of the responsibility for any errors or omissions in the final product. In this respect, we stress that every effort has been made to address this topic as objectively and accurately as possible. There is much about the toxic materials problem that is in flux and thus is still being debated and studied. Throughout the guide we have noted this situation when dealing with specific points. In the introduction, we have also elaborated upon the general attributes of the problem vis a vis teaching, and we encourage you to read that section.

Despite a conscious effort to be fair, both factually and in tone, there is always the danger of falling short of this ideal. We assure you that any such failure has been unintentional. In addition, the activities in Section I have been successfully and safely tested by teachers. It is obvious, however, that any activity can have risk if proper precautions are not taken. For this we cannot assume responsibility. So please follow the suggestions and admonishments given and take whatever other steps are necessary to insure a safe and successful teaching experience.

Lastly, even though this guide represents an extensive collection of teaching resources pertaining to toxic materials, we are very much aware that it is not exhaustive. Many items have come to our attention which we could not review or evaluate. Given the emergence of this issue in the public's mind, we expect even more materials will become available. The items included in this first edition should, however, provide ample support for one's instructional activities.

Suggestions For Using The Guide

This publication has many features to aid social studies and science teachers with instruction about the issue of toxic substances and hazardous wastes -- a crucial area of environmental education. In fact, this appears to be the most extensive guide to such instruction available to date.

Please take a few moments at the outset to read the following four suggestions for using the guide and the summary of features:

1. Be sure to read that often neglected section -- the Introduction. It outlines the assumptions upon which this manuscript rests and summarizes what has been learned about the benefits and possible pitfalls of teaching about this important topic. These conclusions are based on the experiences of nearly 100 teachers and should prove to be a valuable overview to teaching about the issue.

2. Review Section I, Instructional Activities, to get an idea of the variety of instructional approaches that have been developed and evaluated with the help of classroom teachers. They range from simulations and experiments to suggestions about where the topic could be addressed in science and social studies courses.

While reviewing, please note the following points:

a. The activities contribute to achieving many typical science and social studies objectives in general and Virginia Standards of Learning (SOL) in particular. Be sure to refer to Section III to see which SOL's are addressed by which activities.

b. The science and social studies activities have not been grouped separately for fear that doing so might discourage the user from looking at those outside his or her particular area. If this happened the potential contribution of the guide might not be realized, since some of the activities have implications for both areas and all address various aspects of the total issue.

c. No attempt was made to identify a grade level for the activities because the ability of students can vary so greatly. The teacher is in the best position to determine the appropriateness of an activity for a particular group or course. Many of the activities, of course, can be easily modified to make them more appropriate for each teacher's circumstances.

3. Examine the Overview/Background sections of each of the Instructional Activities to acquire an idea about the scope and many facets of the toxic substances and hazardous wastes issue. These sections are relatively brief, but collectively they can provide an interesting survey of some of the problem's many dimensions.

All should start with the Overview/Background section in the first Instructional Activity, "Characteristic of a Toxic Substance". Those with limited science preparation should find the background information in the other instructional activities related primarily to science both helpful and interesting. But in any case, it is especially important, as noted above, not to restrict yourself to those sections related only to your area or interest.

4. Note that a number of audio-visual items have been annotated in Section II and that a variety of supporting material and information has been included in the Appendix. Also note that in addition to this appendix, many of the activities and projects in Section I have appendices. Although these appendices often pertain mainly to the particular project to which it is attached, many have information that could be used with other approaches and activities. An example is the listing of toxic waste sites in Virginia and directions for constructing a salt map found in two of the appendices of "Hazardous Waste Sites and Virginia Geography".

Introduction

The challenge of toxic substances and hazardous wastes has been called one of the most urgent and serious problems facing society today. As such it has many implications for citizenship and scientific preparation of students. Yet, few instructional materials exist to help teachers address this pivotal issue.

This guide is intended to help correct the void by providing classroom-tested instructional ideas and materials and lists of resources for social studies and science teachers. Although meant primarily for teachers in grades seven, eight, and nine, the suggestions should have direct implications for other grades as well.

ASSUMPTIONS

The teaching projects included in this guide were developed for and evaluated in the classroom with the help of a group of teachers from throughout Virginia. The following five assumptions and considerations influenced the development of this guide:

1. Toxic substances are largely a product of the very standard of living which they, in turn, threaten. This reality presents us with a major question. That is, can this threat be defused without destroying present and future standards to which we are accustomed or toward which we are striving?

2. From perspectives of both personal health (at home and in the workplace) and preparation for civic responsibility it is imperative that students develop the necessary understandings and skills to address the problem intelligently.

3. The dilemma is as much a social issue (involving political, economic, geographic, and historical questions) as it is a scientific one. Thus, both the social studies and science areas of the curriculum can contribute to an understanding of the problem and what is involved in trying to resolve it.

4. Social studies and science courses in the middle grades provide an excellent opportunity to introduce aspects of the problem to as many students as possible.

5. Beyond the obligation for teachers to consider such a pivotal issue for our society, there are certain distinct

instructional advantages to using this topic to achieve existing course objectives. These, along with some possible pitfalls, will be noted in the next section when we elaborate upon these five considerations and assumptions.

IMPORTANT CONSIDERATIONS IN TEACHING ABOUT TOXIC SUBSTANCES AND HAZARDOUS WASTES

Toxic materials constitute a complex, controversial, and widespread threat to the quality of our life. It is, therefore, not surprising that the topic presents teachers with many opportunities to develop understandings, skills, and attitudes consistent with their course objectives.

Accompanying these opportunities are, as usual, some possible pitfalls which can be minimized by being aware of them. With this in mind and because the topic is a relatively new one for many teachers, it is well to consider at the outset some of the characteristics of the problem and to comment on their implications for instruction.

The Problem and Implications for Instruction:

1. The toxic materials problem can, and often does, manifest itself either dramatically or insidiously. The former can result in hysteria, the latter in indifference. It is important for students to realize that both reactions become part of the problem and exacerbate it. Once students realize that these responses often result from being ill-informed individuals, they then can explore, along with the teacher how the respective social studies and science courses can address the situation constructively.

2. These dramatic and insidious qualities have proven to be extremely valuable in stimulating student excitement and interest concerning the problem. These qualities are liabilities only if students do not have a chance to use their emotional involvement to develop the necessary skills and knowledge for a more systematic, disciplined study of the problem.

3. There is no question that the topic is controversial. The controversy, however, does not dispute the importance of dealing with toxic substances and hazardous wastes. Instead, the conflicting views usually focus on such concerns as the best way of approaching the situation and the criteria for making the choice. There are just no final answers about many aspects of the problem, since they often involve such things as inadequate data, trade-offs, and such questions as relative risk and short and long-run costs.

Obviously, there is a responsibility to start preparing students to think intelligently about this and other controversies. But what are some specific implications of such preparation? Here are several that are either addressed directly by, or can easily grow out of the instructional activities included in this guide:

(A) For a number of students it is disquieting when they do not get neat answers that are final and complete. When such answers are not forthcoming, they become frustrated, and attention span may diminish. Or they become vulnerable to the quick but inadequate response -- the short-run fix. In these respects they probably differ little from the rest of the population. In fact, expecting quick solutions furnished by someone else has been cited as a characteristic of our time. In any case, when analyzing the toxic substances problem, students should be made aware of these human tendencies, especially since they are antithetical to good learning habits in science and the social studies as well as to effective civic responsibility.

(B) As might be expected, there is a plethora of statistics being generated by those interested in the issue. This provides an opportunity to consider the ability of figures to clarify and make problems more manageable as well as to confuse and distort them, particularly when the statistics seem contradictory. Students should realize that the confusion or distortion may result from the constant flow of new findings and not from deliberate effort to distort. In addition, discrepancies could be due to the use of different working definitions or assumptions. For example, it has been estimated that the amount of hazardous waste generated in this country is equivalent to three to four hundred pounds per person. Another estimate comes up with a much higher figure by using a broader definition of hazardous waste. Yet, both are honest attempts to convey accurately the magnitude of the problem. Of course, there is always the possibility that findings, whether sound or not, may be intentionally presented in a self-serving or distorted manner. This too should be recognized.

(C) Students should be aware of another factor that can diminish subliminally the quality of their thought process or inquiry. That is our tendency to hear what we want to hear. Few of us would consciously have the attitude "don't confuse me with facts, I have made up my mind". But this is a real possibility, particularly involving a topic with the potential emotional impact as that of toxic materials. The tendency can be so subtle that it may even affect those who are aware of it. An existing favorable or unfavorable impression about environmentalists, corporations, government, etc. might result in unintentionally not interrogating positions with which we are sympathetic as thoroughly as those about which we are not. The tendency might be enhanced if the position also appears to be a quick solution -- a propensity noted above.

(D) Any topic that is polemical provides an opportunity for students to practice the skill of differentiating between fact and opinion. And the issue of toxic materials is no exception. Students also can become aware of how assumptions and hypotheses are derived, and how they can possibly lead to establishing a fact. A further insight for students would be that facts, whether in the social sciences or sciences, are continually being tested, so once a fact becomes such, it may not always be so.

Students can see that just as facts are subject to testing, so ideally should opinions, and the changing status of what we know or don't know as fact should be one of those tests. They should recognize that this involves a willingness to have one's opinions challenged -- an attitude often missing even when professed. Also it should become apparent that this necessitates maintaining a long-term interest in the problem -- another vital ingredient to effective citizenship that is too often missing. Beyond these considerations, students can weigh the role of one's values and priorities in formulating opinions and the trade-offs involved.

4. The complexity of the toxic substances issue means that almost all areas of the social sciences and sciences can contribute to understanding the problem. Just as significantly, as suggested earlier, studying about the problem reciprocates by providing a high-interest topic appropriate for developing skills and understandings from the various social science and science disciplines. The opportunities are therefore numerous for integrating this extremely important topic into the curriculum.

Two other instructional possibilities result from the topic's complexity. Students could see how such a problem is approached (defined, dissected) to make the questions being pursued more manageable. They could gain from this an appreciation of the importance of asking the "right" questions.

A second possibility, related to the previous one, is to show how different discipines within the social sciences and sciences can help address the problem. This will help promote insight into the interrelationship among the disciplines.

Naturally, the extent to which such considerations can be addressed will be influenced by the ability of the students. Yet, it seems reasonable that students of all ability levels should at least be aware of such items as noted in this section.

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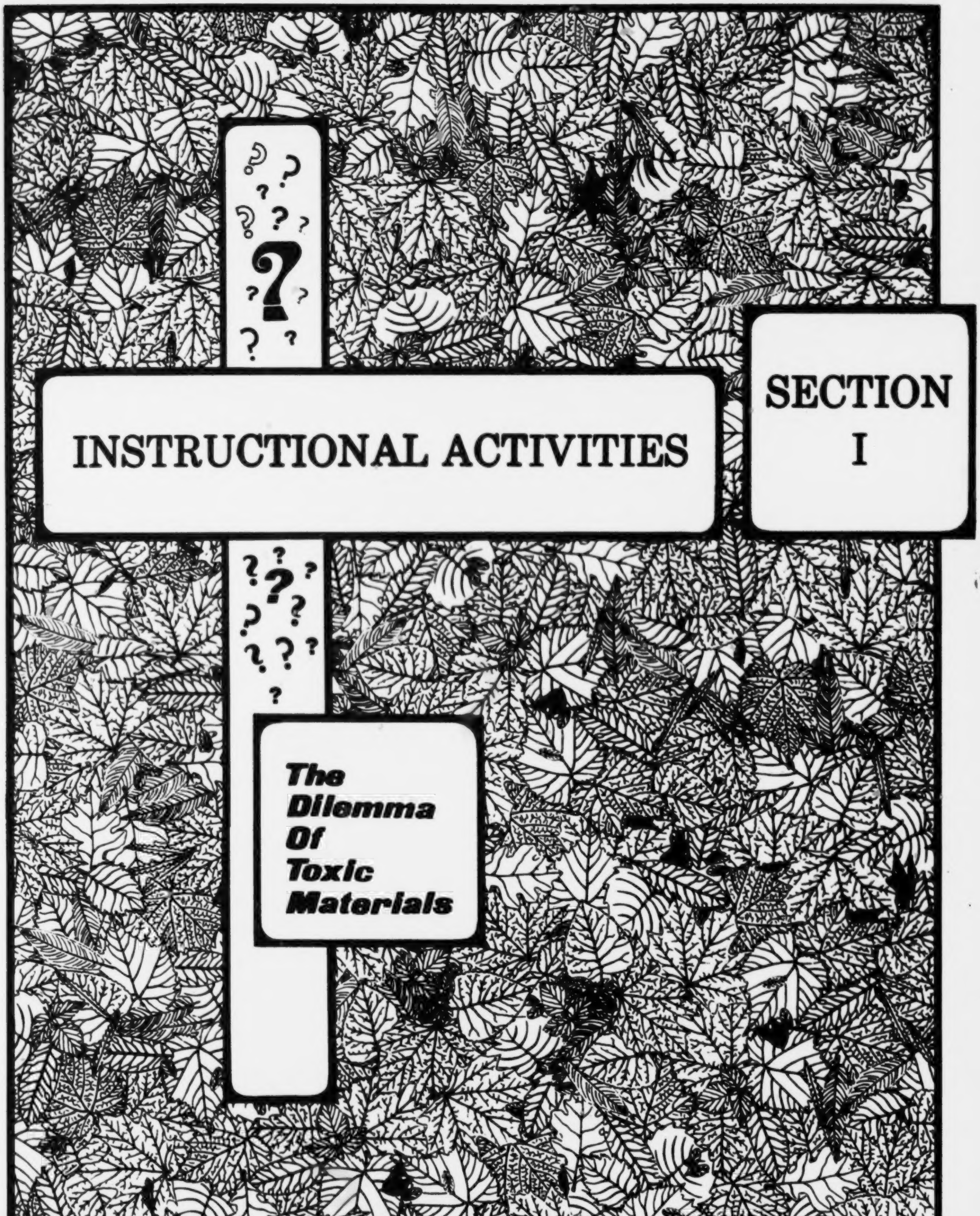

SECTION I

INSTRUCTIONAL ACTIVITIES

The Dilemma Of Toxic Materials

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Characteristics Of A Toxic Substance

MAJOR PURPOSES

*To define a "toxic substance"
*To provide examples of the four major characteristics of toxic substances

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS/QUESTIONS

*To illustrate toxicity, to demonstrate corrosiveness, reactiveness and ignitability
*To provide a listing and classification of toxic substances
*To define pollution

INSTRUCTIONAL APPROACH

This is a teacher-demonstration for the physical, life, earth, or general science class. The chemical aspects of this demonstration should be completed under a hood and, if one is not available, it should be done outside when the weather is dry. The teacher must practice the experiments using appropriate safety precautions such as goggles, hood, remote handling and control devices, gloves and laboratory apparel. The students SHOULD NOT BE PERMITTED to do these chemical experiments on their own. The teacher should provide proper disposal of materials remaining after experimentation.

For demonstration of toxicity, photographs from magazines or newspaper pictures of fish kills would be appropriate. A dead plant or the remains of a flower could be used effectively. The instructor may want to develop a series of slides to show responses of biological systems to toxins, chemicals and environmental changes. The dangers of large scale duplication of any dangerous demonstrations should be emphasized by the teacher. Students may be asked to know 10 substances from the list of toxic pollutants. They may also be asked to research the use and characteristics of some of the other chemicals on the list.

For some highly effective demonstrations of the characteristics of a toxic substance the teacher may want to invite the local fire department and its Hazardous Incident Team in for a demonstration. This demonstration would probably be done outside or at their training site. Some states have special hazardous incident teams affiliated with their health department, state police and office of emergency services. It is suggested that the teacher consider asking them to give a demonstration, to provide films, video tapes or interact with their training officer or an official in a private hazardous waste disposal firm. Even if only photographs are available and an emergency telephone number is all that is gained, it will be beneficial.

OVERVIEW/BACKGROUND

Defining a toxic substance is not easy. The following interpretations are from the book, "The Toxic Substances Dilemma" edited by Segel, Kamlet, Clark, Veraska and Lowe and published by the National Wildlife Federation (1980). "Congress avoided an explicit definition of "toxic" in passing the Toxic Substances Control Act (TSCA) and failed to even use the term "toxic" except in the title. The EPA, which has the responsibility of enforcing the act stated, "The main obstacle is the lack of a precise or even a semi-precise definition of what constitutes a toxic material. The line of demarcation between a toxic and a non-toxic material is so ambiguous that it is almost hopeless..."

"In the broadest sense, a toxic substance is one which can produce some adverse biological effect or damage in a living organism, be it man, animal, plant or other system. But this definition is not very helpful. Every chemical can be toxic if too much of it is present, that is, if its concentration is too high for the particular circumstance. Water is toxic to a person submerged in it. It has been well said that there are no harmless substances, only harmless ways of using substances. It is just as valid that there are no toxic substances, only harmful ways of using substances. Strychnine is harmless as long as it remains in a sealed vial. Drinking excessive amounts of even water can kill as is reported in the news article shown in Figure 1.

The Toxic Substances Control Act covers these two main points in an attempt to protect human health and the environment:

1. Human beings and the environment are being exposed each year to a large number of chemical substances and mixtures

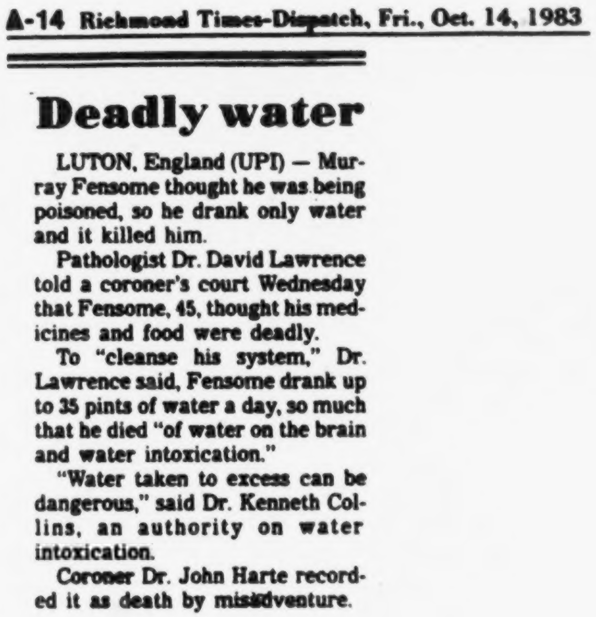
2. Among the many chemical substances and mixtures which are constantly being developed and produced, there are some whose manufacture, processing, distribution in commerce, use or disposal may present an unreasonable risk of injury to health or the environment

By indirection, Congress has thus defined a toxic substances as a chemical or mixture whose manufacture, processing, distribution, use, or disposal may present an unreasonable risk of injury to health or the environment. Such substances or mixtures are the ones to be regulated. The key words in this definition are "unreasonable risk."

A toxic substance or toxic chemical usually has value and a definite use. A hazardous waste or toxic waste is often characterized as being toxic and "dangerous" but having little or no use and no economic value. Thus there is a need to dispose, recycle, neutralize, store or just simply make sure that such materials are not dumped into the environment.

The terms "pollutant" and "toxic substance" are often used interchangeably. This usage is convenient but misleading and imprecise according to Segel et al. (1980). Just as all cats are animals, but not all animals are cats-- all toxic substances are pollutants, but not all pollutants are toxic substances. Pollutants, in the broadest sense, are all materials which enter the environment as a direct or indirect result of man living on earth. Pollutants thus include human biological wastes, garbage, the smoke from cigarettes and factory smokestacks, the emissions from homes, offices, cars, trucks and industrial plants. Environmentalists also classify as pollutants excessive amounts of noise and heat. The latter is often in reference to water being returned after use as a coolant. Pollutants may or may not be harmful to human beings and the environment, may or may not be harmlessly absorbed by the environment. Not so with toxic substances. A pollutant is a toxic substance when it causes an unreasonable risk to human health or he environment. Deciding which pollutants are toxic substances can be complex and difficult."

Figure 1. A Newspaper Clipping From the Richmond Times-Dispatch Indicating A Case of Water Intoxication.



A-14 Richmond Times-Dispatch, Fri., Oct. 14, 1983

Deadly water

LUTON, England (UPI) — Murray Fensome thought he was being poisoned, so he drank only water and it killed him.

Pathologist Dr. David Lawrence told a coroner's court Wednesday that Fensome, 45, thought his medicines and food were deadly.

To "cleanse his system," Dr. Lawrence said, Fensome drank up to 35 pints of water a day, so much that he died "of water on the brain and water intoxication."

"Water taken to excess can be dangerous," said Dr. Kenneth Collins, an authority on water intoxication.

Coroner Dr. John Harte recorded it as death by misadventure.

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Toxic substances are chemicals or materials which can harm, contaminate, or kill living organisms because they have ignitable, corrosive, reactive or toxic characteristics. They may be primary products or produced as by-products of chemical and industrial production. They may be toxic wastes because they seemingly have no other use. The four main characteristics of toxic substances are:

1. Toxicity - This is poisonous and harmful to human health. These substances can kill (toxic and lethal), cause cancer (carcinogens), cause birth defects (teratogens), alter genetic material (mutagens) and can harm or kill fish, wildlife and in some cases, even humans.

2. Corrosiveness - These substances can corrode storage containers or damage human tissue if touched.

3. Reactiveness - These substances are unstable and could react if exposed to heat, shock, air or water.

4. Ignitability - These substances could explode, catch on fire or emit toxic gases into the environment.

Examples of toxic substances are DDT, asbestos, cyanide, lead, PCB´s, mercury, and kepone. Since many students do not understand the above terms, this lesson seeks to illustrate safely and somewhat vividly, via demonstration, guest lecture, or film, these characteristics.

DEMONSTRATIONS

ALL EXPERIMENTS AND DEMONSTRATIONS REQUIRE THE USE OF SAFETY GLASSES AND APRONS

Toxicity

Photographs from magazines, slides or newspaper articles, pictures of dead animals, plants or fish kills can be used to illustrate the lethal aspect of toxicity.

Toxicity can be acute, that of causing death in a short time period, usually in less than a week or a month or it can be chronic toxicity that leads to illness and eventual death after months or years of exposure to the agent. Normally we think of toxicity as acute, causing immediate or near immediate death.

The amount of agent causing death is often related to the time it takes to kill the organism and the number of organisms (%) killed. A commonly used procedure is that of determining the LD_{50}, lethal dose to 50% of the organisms. Also the LC_{50}, lethal concentration which the organism lives in that will cause 50% of them to die. The latter is usually associated with fish and aquatic organism. For the LD_{50}, the amount of toxin is usually considered in relation to the mg of toxin administered or fed to an organism based on its body weight in kg. Since few test organisms weigh one kg, proportional calculations are applied to the amount of toxin that is required to kill 50%, yet toxic amounts are usually reported in mg/kg of organism.

An optional experiment that the students could do or the teacher could demonstrate involves the use of milkweed bug eggs. Other beetle/insect eggs that are available can also be used. Such eggs (milkweed bug) are available from Carolina Biological Supply Co. in Burlington, NC and a sufficient amount for demonstrations and the starting of a culture cost less than $20. Cultures may be maintained indefinitely. The eggs are microscopic and would require the use of a good hand lens or stereomicroscope and a dissecting needle to tease apart and move the eggs. They are yellow, change color, and emerge from the egg case if they hatch. Thus it is possible to set up the following experiment to show the effect of exposures to various chemicals such as salt water or insecticides on the percent hatchability and time to hatch of these eggs. It is suggested that you start your own colony of bugs and collect the eggs as they are laid. There is no fear that this strain will escape and become a problem in the environment or into the building because they have been adapted to feed and they can survive only upon raw and unsalted sunflower seeds.

Make a salt solution of 10 grams/100 ml and dip 10 eggs into it for 30 seconds, 10 eggs for 1 minute and so on for upto 5 minutes. Rinse the eggs immediately after removal with tap water from a medicine dropper. Treat another set of eggs (control) only with tap water also for the same interval of time. A teabag strainer will serve as a nice dipping instrument. Remember to rinse it between uses. Collect the eggs on filter paper and label their time of exposure and treatment. Observe them daily for upto 10 days recording date and number hatching.

Have the students determine the length of time of exposure to the salt water or the insecticide that causes a 50% loss in hatchability. In a way they are determining the lethal time for 50% of the hatchable eggs.

Carolina Biological Supply Co. has a nice free guide to handling and the care of the milkweed bug, Oncopeltus fasciatus. Consider asking for it when you make your purchase.

This is a long-term experiment and would be a nice project for several students which could provide the beginnings for a competitive "fair" project. It may require upto a month to raise sufficient animals for egg production. The use of salt solutions are obviously recommended over that of insecticides or other more dangerous chemicals and metal-containing compounds.

Corrosiveness

Place a plain iron (steel, non-coated, non-galvanized) nail into a 10% solution of copper sulfate (10g/100 ml water). After a few minutes the part of the nail that is in the solution will be noticeably reduced in size. This is an example of corrosion.

An alternative method would be to place a small wad of fine steel wool in water. After a few hours the rust or corrosion will be evident.

Please dispose of these chemicals via approved procedures which is usually to an appropriate landfill.

You may want to discuss other examples of corrosion with your students. These could include that of a strong acid (and the warning symbol for this) or even the oxidation of aluminium.

Reactiveness

For reactiveness and ignitability we recommend a film or tape be used, or a demonstration by a professional hazardous incident team specialist. We do not recommend the classic examples of using a small piece of sodium metal and water even if a hood is available.

A recommended experiment would be to add 10 grams of baking soda to 100 ml of vinegar. The reaction will be rapid and it will fizz. Be sure that the beaker is at least a 500 ml size to contain the reaction. Better yet, utilize some powder or a tablet of an effervescent agent such as "Alka-Seltzer" in some water to produce the bubbling effect from the carbon dioxide/carbonic acid. A 3 - 4 gram tablet of denture cleanser such as Efferdent can be placed in 8 ounces of warm water or about 200 - 300 ml and the reaction will be dramatic with a blue color first followed by the clearing of the color. Each of the above reaction products may be diluted and safely disposed of via the normal sewage system.

Ignitability

Strike a match. The reaction produces a flame which illustrates ignitability by addition of heat, friction from the box. Utilize a safety match and discuss the chemicals and heat involved.

As an alternative demonstration we suggest that you use a camera and flash bulb, taking care not to flash the bulb directly and at close distance into the eyes and remembering that the bulb is hot for a minute or two after the flash. Ask the student to explain the ignition of the magnesium filament and why it is contained within glass or plastic. Have several types of flash bulb that have been opened before and after flashing. Enclose these bulbs in sealed Petri dishes so they do not disappear. Give the students a history of some of the accidents associated with flashing devices used by early photographers but do not demonstrate the burning of magnesium ribbon unless you have a hood and eye protection.

A film or video-tape reaction that is a dramatic example of reactiveness and ignitability involves the use of solid swimming pool bleach and brake fluid. This should not be done by the teacher even if a hood is available. The humidity and potential for an accident absolutely supports that a film or professional provide such a demonstration. We again recommend a film or field trip to show this type of demonstration. Consider having the local hazardous incident team demonstrate this.

The reaction above is exothermic and liberates 60% free chlorine gas which is dangerous so an explosion proof hood or outside open field is needed. The dryer the bleach, sodium hypochlorite ($NaHClO_3$), the slower the reaction. If a plastic cup is used and it burns there will be some hydrocyanic gas with an almond smell. It is also dangerous. The brake fluid is a hydrocarbon. Both bleach and brake fluid are available from stores such as K-Mart so DO NOT TELL OR

ENCOURAGE YOUR STUDENTS TO TRY THIS. We only share this with you since it is a commonly used training demonstration and some students may ask about it since it is often shown on television.

SHORT ANSWER QUESTIONS

1. List the four main characteristics of a toxic substance. ________________ ________________ ________________ ________________	corrosive toxic reactive ignition
5. Pollutants are always toxic.	No
6. Hazardous waste normally has substantial value.	False/no
7. The abbreviation for 50% lethality is.	LD_{50}
8. Give the term used for a chemical that causes cancer.	carcinogen
9. Is asbestos a toxic pollutant and on the priority list?	yes
10.Who proposed the Priority Toxic Pollutant List?	EPA

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"Hazardous Waste", A Concern Publication, Concern, Inc., 1794 Columbia Rd, N.W., Washington, DC, 20009.

"Deadly Water", Richmond Times-Dispatch, Friday, October 14, 1983.

VOCABULARY

Toxic, toxicity, toxic substance, pollutant, hazardous waste, toxic waste, corrosiveness, reactiveness, ignitability, carcinogen, mutagen, teratogen, LD_{50}, concentration, bleach, match chemistry, rust, copper sulfate, sodium bicarbonate, effervescence, TSCA, unreasonable risk, vinegar, EPA, kepone, DDT, asbestos

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1. Priority Toxic Pollutants

1. *acenaphthene
2. *acrolein
3. *acrylonitrile
4. *benzene
5. *benzidine
6. *Carbon tetrachloride (tetrachlormethane)

*__chlorinated benzenes__ (other than dichlorobenzenes):

7. chlorobenzene
8. 1,2,4-trichlorobenzene
9. hexachlorobenzene

*__chlorinated ethanes__ (including 1,2-dichloroethane, 1,1,1-trichloroethane and hexachloroethane):

10. 1,2-dichloroethane
11. 1,1,1-trichloroethane
12. hexachloroethane
13. 1,1-dichloroethane
14. 1,1,2-trichloroethane
15. 1,1,2,2-tetrachloroethane
16. chloroethane

*__chloroalkyl ethers__ (chloromethyl, chloroethyl and mixed ethers):

17. bis (cholorometyl) ether
18. bis (2-chloroethyl) ether
19. 2-chloroethyl vinyl ether (mixed)

*__chlorinated naphthalene:__

20. 2-chloronaphthalene

*__chlorinated phenols__ (other than those listed elsewhere; includes trichlorophenols and chlorinated cresols):

21. 2,4,6-trichlorophenol
22. parachlorometa cresol
23. *chloroform (trichloromethane).
24. *2-chlorophenol

*__dichlorobenzenes:__

25. 1,2-dichlorobenzene
26. 1,3-dichlorobenzene
27. 1,4-dichlorobenzene
28. 3,3-dichlorobenzidine

*__dichloroethylenes__ (1,1-dichloroethylene and 1,2-dichloroethylene):

29. 1,1-dichloroethylene
30. 1,2-trans-dichloroethylene
31. *2,4-dichlorophenol

*__dichloropropane and dichloropropene:__

32. 1,2-dichloropropane
33. 1,2-dichloropropylene (1,3-dichloropropene)
34. *2,4-dimethylphenol

*__dinitrotoluene:__

35. 2,4-dinitrotoluene
36. 2,6-dinitrotoluene
37. *1,2-diphenylhydrazine
38. *ethylbenzene
39. *flouranthene

*__Haloethers__ (other than those listed elsewhere):

40. 4-chorophenyl phenyl ether
41. 4-bromophenyl phenyl ether
42. bis (2-chloroisopropyl) ether
43. bis (2-chloroethoxy) methane

*__halomethanes__ (other than those listed elsewhere):

44. methylene chloride (dichloromethane)
45. methyl chloride (chloromethane)
46. methyl bromide (bromomethane)
47. bromoform (tribromomethane)
48. dichlorobromomethane
49. trichloroflouromethane
50. dichlorodiflouromethane
51. chlorodibromomethane
52. *hexachlorobutadiene
53. *hexachlorocyclopentadiene
54. *isophorone
55. *naphthalene
56. *nitrobenzene

*__nitrophenols__ (including 2,4-dinitrophenol and dinitrocresol):

57. 2-nitrophenol
58. 4-nitrophenol
59. *2,4-dinitrophenol
60. 4,6-dinitro-o-cresol

*__nitrosamines:__

61. N-nitrosodimethylamine
62. N-nitrosodiphenylamine
63. N-nitrosodi-n-propylamine
64. *pentachlorophenol
65. *phenol

*__phthalate esters:__

66. bis (2-ethylhexyl) phthalate
67. butyl benzyl phthalate
68. di-n-butyl phthalate.
69. di-n-octyl phthalate
70. diethyl phthalate
71. dimethyl phthalate

*__polynuclear aromatic hydrocarbons:__

72. benzo (a) anthracene (1,2-benzanthracene)
73. Benzo (a) pyrene (3,4-benzopyrene)
74. 3,4-benzoflouranthene
75. benzo (k) flouranthane (11,12-benzoflouranthene)
76. chrysene
77. acenaphthylene
78. anthracene
79. benzo (ghi) perylene (1,2-benzoperylene)
80. phenathrene
81. fluroene
82. dibenzo (a,h) anthracene (1,2,5,6-dibenzanthracene)
83. indeno (1,2,3-cd) pyrene (2,3-o-phenylenepyrene)
84. pyrene
85. *tetrachlorethylene
86. *toluene
87. *trichloroethylene
88. *vinyl chloride (chloroethylene)

pesticides and metabolites:

89. *aldrin
90. *dieldrin
91. *chlordane (technical mixture & metabolites)

DDT and metabolites:

92. 4,4'-DDT
93. 4,4'-DDE (p.p'-DDX)
94. 4,4'-DDD (p.p'-TDE)

*__endosulfan and metabolites:__

95. a-endosulfan-Alpha
96. b-endosulfan-Beta
97. endosulfan sulfate

*__endrin and metabolites:__

98. endrin
99. endrin aldehyde

*__heptachlor and metabolites:__

100. heptachlor
101. heptachlor epoxide

*__hexachlorocyclohexane__ (all isomers):

102. a-BHC-Alpha
103. b-BHC-Beta
104. r-BHC (Lindane)-Gamma
105. g-BHC-Delta

*__polychlorinated biphenyls__ (PCB's)

106. PCB-1242 (Arochlor 1242)
107. PCB-1254 (Arochlor 1254)
108. PCB-1221 (Arochlor 1221)
109. PCB-1232 (Arochlor 1232)
110. PCB-1248 (Arochlor 1248)
111. PCB-1260 (Arochlor 1260)
112. PCB-1016 (Arochlor 1016)
113. *Toxaphene
114. *Antimony (Total)
115. *Arsenic (Total)
116. *Asbestos (Fibrous)
117. *Beryllium (Total)
118. *Cadmium (Total)
119. *Chromium (Total)
120. *Copper (Total)
121. *Cyanide (Total)
122. *Lead (Total)
123. *Mercury (Total)
124. *Nickel (Total)
125. *Selenium (Total)
126. *Silver (Total)
127. *Thallium (Total)
128. *Zinc (Total)
129. *2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)

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*Specific compounds and chemical classes as listed in the consent decree.

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2. Priority Toxic Pollutants By Classes

Pollutant	Characteristics	Sources
Pesticides Generally chlorinated hydrocarbons	Readily assimilated by aquatic animals, fat soluble, concentrated through the food chain (biomagnified), persistent in soil and sediments	Direct application to farm- and forestlands, runoff from lawns and gardens, urban runoff, discharge in industrial wastewater
Polychlorinated biphenyls (PCBs) Used in electrical capacitors and transformers, paints, plastics, insecticides, other industrial products	Readily assimilated by aquatic animals, fat soluble, subject to biomagnification, persistent, chemically similar to the chlorinated hydrocarbons	Municipal and industrial waste discharges disposed of in dumps and landfills
Metals Antimony, arsenic, beryllium, cadmium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc *Other inorganics* Asbestos and cyanide	Not biodegradable, persistent in sediments, toxic in solution, subject to biomagnification *Asbestos* May cause cancer when inhaled, aquatic toxicity not well understood *Cyanide* Variably persistent, inhibits oxygen metabolism	Industrial discharges, mining activity, urban runoff, erosion of metal-rich soil, certain agricultural uses (e.g., mercury as a fungicide) *Asbestos* Manufacture and use as a retardant, roofing material, brake lining, etc.; runoff from mining *Cyanide* Wide variety of industrial uses
Halogenated aliphatics Used in fire extinguishers, refrigerants, propellants, pesticides, solvents for oils, and greases and in dry cleaning	Largest single class of "priority toxics," can cause damage to central nervous system and liver, not very persistent	Produced by chlorination of water, vaporization during use
Ethers Used mainly as solvents for polymer plastics	Potent carcinogen, aquatic toxicity and fate not well understood	Escape during production and use
Phthalate esters Used chiefly in production of polyvinyl chloride and thermoplastics as plasticizers	Common aquatic pollutant, moderately toxic but teratogenic and mutagenic properties in low concentrations; aquatic invertebrates are particularly sensitive to toxic effects; persistent; and can be biomagnified	Waste disposal vaporization during use (in nonplastics)
Monocyclic aromatics (excluding phenols, cresols and phthalates) Used in the manufacture of other chemicals, explosives, dyes and pigments, and in solvents, fungicides, and herbicides	Central nevous system depressant; can damage liver and kidneys	Enter environment during production and byproduct production states by direct volatization, wastewater
Phenols Large volume industrial compounds used chiefly as chemical intermediates in the production of synthetic polymers, dyestuffs, pigments, pesticides, and herbicides	Toxicity increases with degree of chlorination of the phenolic molecule; very low concentrations can taint fish flesh and impart objectionable odor and taste to drinking water; difficult to remove from water by conventional treatment; carcinogenic in mice	Occur naturally in fossil fuels, waste water from cooking ovens, oil refineries, tar distillation plants, herbicide manufacturing, and plastic manufacturing; can all contain phenolic compounds
Polycyclic aromatic hydrocarbons Used as dyestuffs, chemical intermediates, pesticides, herbicides, motor fuels, and oils	Carcinogenic in animals and indirectly linked to cancer in humans: most work done on air pollution; more is needed on the acquatic toxicity of these compounds; not persistent and are biodegradable though bioaccumulation can occur	Fossil fuels (use, spills, and production), incomplete combustion of hydrocarbons
Nitrosamines Used in the production of organic chemicals and rubber; patents exist on processes using these compounds.	Tests on laboratory animals have shown the nitrosamines to be some of the most potent carcinogens.	Production and use can occur spontaneously in food cooking operations

From: Environmental Quality. Ninth Annual Report of the Council on Environmental Quality. U.S. Government Printing Office, Stock No. 041-011-00040-8, December, 1978.

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Water: A Civic Responsibility

MAJOR PURPOSES

*To examine the role of water in our society
*To examine the role of the citizen in maintaining a clean environment

RELATED CONCEPTS/UNDERSTANDINGS/QUESTIONS/SKILLS

*To engage in the process of group decision-making
*To consider origins of water pollution
*To develop an appreciation for a common, threatened resource

INSTRUCTIONAL APPROACH

Students will discuss the role of water and then go on to work in small groups on posters showing the source(s) and destination(s) of tap water. Once the posters are completed, students will pinpoint possible points of contamination for a water supply. Materials needed for the activities are large pieces of paper or posterboard and crayons or magic markers.

Among the places in the curriculum where this activity would be appropriate are the following:

> Social Studies: History (20th century problems, industrial revolution), geography, and civics
>
> Science: Ecology, environmental problems, and nature of water

OVERVIEW

Water is a substance so common to our lives that it is taken for granted. We are used to having water literally on tap just about any time and any place that we need it. As a result, students frequently fail to consider the orgin and value of this resource.

The role of water in our lives is a concept which can be used to raise questions concerning "societal values", such as who "owns" the water? Who decides when and whether water is polluted? What are the possible benefits and liabilities of various usages to our environment?

Small group work is an important method to use, especially with middle school students. While students have the "security" of a group, they also have individual responsibilities as a member of the group. Having students design posters provides them with an opportunity for self-expression while demonstrating knowledge of subject matter. From this project, students will have a graphic picture of the sources and destinations of water.

In addition, students will gain confidence in themselves by pulling together bits and pieces of knowledge from their own experience and adding it to the others' in the group. They will brainstorm places and ways in which our water becomes polluted. And finally, they will decide how each one, as an individual, can help keep our water clean.

ACTIVITY

1. Teacher holds up a glass of water or runs the faucet. Ask one or more of the following: What can this teach us today? What is this good for? Why do we need this? How is this important to us?

Put student answers on the board (to emphasize the vast number of ways in which we are dependent upon it).

Some ideas:

use in rituals
boundaries
location of settlements
role of water in our bodies
swimming pools
washing machines

(for more ideas see Water, listed in the reference section)

2. Ask: Do you ever worry about having enough water?
Why or why not?
If not, what makes you sure that it will always be available?
Can you trust that someone else will take care of your water supply for you?
How can you make sure that the "caretakers" are doing their jobs?
If you do worry about it, what can you do about the situation?

3. State that today they're going to find out that they are **already** experts on the subject of water.

4. Divide students into groups of 4 - 6. Send to stations. Each station has a large piece of paper with a faucet drawn in the middle and something with which each of them will draw.

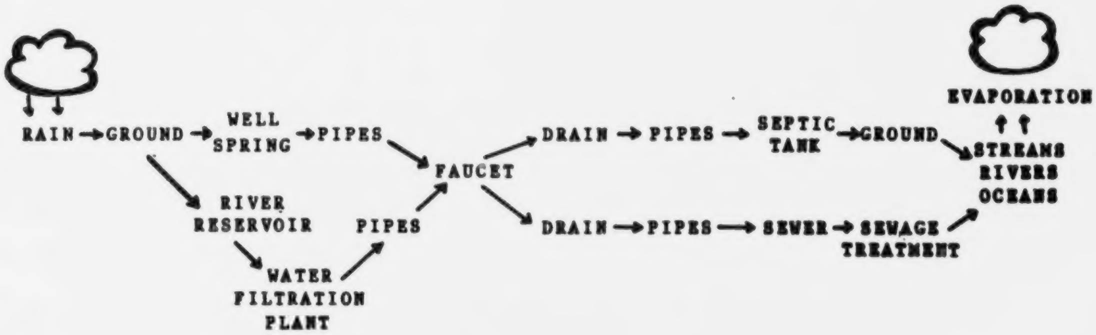
5. Instruct students that as a group they are to make a poster showing how water gets to and from their homes. They should trace water as far from the faucet as possible. Can you trace it back to the cloud? Can you trace it to the ocean?

6. Teacher's role:

a) Be knowledgeable about your local water supply and waste-water treatment. Be aware that some students may have city water and sewer while others may have springs and wells and septic tanks. If this is the case you will need to address the problem to avoid confusion.

b) The teacher will circulate among the groups, prompting them with questions and clarifying problems.

c) Diagrams should be some facsimile of the following:


RAIN
GROUND
WELL
SPRING
PIPES
RIVER
RESERVOIR
WATER
FILTRATION
PLANT
PIPES
FAUCET
DRAIN
PIPES
SEPTIC
TANK
GROUND
DRAIN
PIPES
SEWER
SEWAGE
TREATMENT
EVAPORATION
STREAMS
RIVERS
OCEANS

7. On board, do a composite of their ideas. you may include both "city" and "country" types of systems for maximal use of the lesson format.

8. Have them examine their own posters to see what aspects they have omitted and what may be out of order.

9. Now, using the diagram on the board, the class will examine possible points of pollution:

a) Ask: Is rain pure? Is the groundwater pure?
(we used to assume so)
What is happening to the rain? (acid rain)
What is happening to groundwater? (urban runoff, pesti-

cides, herbicides)

b) Where else (refer to the diagram) could your water become contaminated?

Suggested answers:

At well: insect larvae, chemicals leaching
In a river or reservoir: (Richmonders will remember "algae water"), kepone
In pipes: corrosion of pipes

10. Ask: What happens to water if it becomes polluted?

Can you smell it? Taste it? (not always)
Is all water that smells or tastes strange bad for you? (no, example: sulfur water)
What happens if you drink or swim in polluted water?
Do you necessarily know?
Do you necessarily get sick?
If you get sick is it always right away?

11. Ask: What can we do to help keep our water clean?

Some ideas:
Responsible citizenship
Be careful of what we put down the drain

EXTENSIONS AND RESOURCES

1. Be Water Wise by the Virginia Water Resources Research Center, Blacksburg, Va., 1982.

   A well-illustrated simple-to-understand booklet on how water gets to and from our homes and on water conservation. Excellent for background information on sewage treatment and water filtration. Dittos for worksheets are available.

2. Water: The Nature, Uses, and Future of Our Most Precious and Abused Resource by Fred Powledge, New York, 1982.

   Ideal for the background information on the water molecule and its unique properties. Case studies.

ACKNOWLEDGMENT

This revised and edited version was originally developed and evaluated by Lynn Wilson, faculty member of Varina High School, Richmond, Va.

Environmental Legislation: Benefits And Limitations

MAJOR PURPOSES

*To examine possible benefits and limitations or liabilities of seeking solutions through legislated regulations
*To become familiar with one of the major pieces of environmental legislation

RELATED CONCEPTS/UNDERSTANDINGS/QUESTIONS/SKILLS

*To introduce the process of a bill becoming a law
*To recognize the role and influence of citizens and pressure groups
*To appreciate the problem of wording effective legislation
*To appreciate the importance of public awareness despite legislation
*To consider the relationship of public to private sector
*To develop an awareness of human effects on the environment

INSTRUCTIONAL APPROACH

The instructional approach employed in this project is a case study of the Resource Conservation and Recovery Act of 1976 (RCRA).

OVERVIEW

The problem of toxic substances provides an excellent opportunity for students to weigh the extent to which government should and can "solve problems through regulation" -- a question appropriate for examining in almost any social studies course but especially in history, geography, civics, and government. This project uses the Resource Conservation and Recovery Act of 1976 (RCRA) to examine possible benefits and limitations or liabilities of government regulation.

The role of government regulation is not only a complex contemporary issue but also a historic one, having been debated in one form or another ever since our constitution provided for limits on government authority. It is certainly unlikely that the following questions represent transient concerns as long as we have an open-ended, free society: What are our present attitudes toward government regulation? Have they changed? If they have, why? What are the implications of the change -- in terms of our life styles, political and economic rights and responsibilities, environment, values, attitudes, etc.? For instance, has the attitude emerged that most problems can be solved by regulation? Or could we assume that once legislation is passed, the problem has been resolved and no further attention need be paid to it by citizens?

REASONS FOR THE APPROACH:

The nature of the Resource Conservation and Recovery Act of 1976 makes it especially appropriate for a case study that would address such questions as those noted above. This act provides a major regulatory program designed to insure responsible management of hazardous wastes at all levels. The "cradle to grave" coverage includes generation, transportation, storage, and disposal of all toxic substances. As part of the monitoring program a manifest system was initiated so that written documentation must exist for every phase of the life of any toxic substance. The documentation is to show who handled the substances and how. Thus, responsibility could be more readily established if difficulties occurred.

Using a case study has several benefits: students are more interested and their attention more readily captured and held by concrete rather than by abstract examples. A more intensive study of one aspect of a large question encourages students to develop critical thinking skills. Students develop a deeper understanding of the whole by examining the individual parts. Put another way, using a case study to simplify a complex issue allows for a study of details while not losing sight of the overall complexity and importance of the issue -- a valuable aspect of critical thinking.

Questions and topics, other than those noted thus far, could appropriately be considered, depending upon the course. Some of these will be noted later.

INTRODUCTION TO ACTIVITIES:

As might be expected most students are unaware of the volume of garbage produced in this country, and even fewer are aware of the distinction between garbage and toxic waste. The opening activity of this project, therefore, is designed to create awareness of the volume and kinds of garbage generated by the average American family. Information derived from this activity can be used to generalize about the enormity of the problem and create interest in further study. From this study students should be able to recognize themselves as part of the problem and see the importance of each individual having such an awareness.

ACTIVITIES

Activity # 1 (about a week before the start of the project)

Without preliminary explanation, instruct students in a week-long homework assignment: weighing the family trash daily! Have students maintain a daily record of the weight of household trash using their home scales or by estimating using a known weight (such as a five-pound bag of flour) for comparison. (This assignment should be given at least a week in advance of the study so that students can tabulate their information to introduce the lesson.) Students whose families have garbage disposals or who are not themselves responsible for "carrying out the trash" should get other family members involved. The activity is bizarre enough to intrigue most everyone but if a student is unable to complete the assignment, the total weight can be estimated using the figures of another classmate's family of similar size.

Activity # 2: Introduction of Study

Have students total the daily weights to arrive at a weekly figure for each family. Find the average weekly total by adding all students' totals and dividing by the number of students. Write the figure on the blackboard and then multiply the figure by 80 million (the approximate number of households in the United States today). The figure should astound the class. To make the figure more meaningful, divide that total by 150 pounds (the weight of an "average" adult) to show how many "people" we dispose of each week. (Of course, this figure doesn't include business and industrial trash which would double, at least, the figure!)

Lead students into a discussion: What things were thrown away? Could any of these be recycled? What happens to the garbage after it leaves the neighborhood? Have you ever considered what happens? Is it important to know? (The teacher will have to become familiar with local regulations regarding trash disposal.) Who is responsible for maintaining the landfill or dump site? How does that person or agency know what is being dumped at the site? Does all trash go to the same place? What happens to waste substances that are dangerous? Should there be some control over these hazardous wastes?

These questions (and others from the teacher's expertise and from student responses) should lead to an introduction by the teacher of RCRA, which was designed to meet the needs of controlling hazardous waste disposal. RCRA is just one of 18 or so major federal laws related to some aspect of toxic materials disposal, but it was the first. A synopsis should give students an awareness of the complexity of federal regulations. (A synopsis of RCRA from the National Wildlife Federation publication, THE TOXIC SUBSTANCE DILEMMA, is provided in the appendix of this publication.)

With the students, search through the synopsis looking for generalities such as "hazardous waste", "substantially equivalent", etc. Consider the use of such generalities in laws. Can laws be written so that they are too specific? What could happen if there is too much decision-making and interpretive powers given to bureaucrats and administrators? Does a non-specific law need further laws to clarify the legislation or does this compound the problem? In short, weigh the problem and considerations in writing regulatory legislation.

Activity # 3: Comparison of Intent and Reality

After the students have studied the overall complexity of RCRA, students should analyze the parts of the Act to compose a list of its major requirements. These include requirements of the EPA (Environmental Protection Agency) Administrator for developing hazardous substances identification criteria, guidelines for state hazardous waste programs, and developing and maintaining a manifest system for reporting the transportation of hazardous substances. (Point out to students one of the problems encountered has been lack of money for monitoring the system.) After students have an idea of the expectations and potential limitations of RCRA, contact a local or state government official who has the responsibility of implementation of RCRA in your area. (The Resource List in this book's Appendix contains names of some possible speakers. Check with your local health department for others.) Ask this person to speak to your class. Consider with the speaker how successful the legislation has been in fulfilling its intended functions.

EXTENSIONS

1. Students could research the history of RCRA. Who supported it? Opposed it? How long did legislation take from proposal to implementation? Does the manifest system work? Why or why not? This project would require a good deal of independent study by the student and would probably be appropriate for honors or advance classes only. If time is a factor or you wish to gather the information, you could prepare the historic information and present it to the class to illustrate the legislative process.

2. To illustrate the difficulty of precise definitions within laws, students could be assigned several terms or processes to research for establishing a working definition. For example, what is "improperly managed"? How do you measure "substantial hazard"? How does one "prohibit the inconsistent application of RCRA?"

IDEAS FOR POSSIBLE SPECIFIC COURSE APPLICATION

This case study could be used to consider the following topics in the courses indicated:

1. Civics Classes: How a bill becomes a law. How citizens and pressure groups influence legislation. Do benefits outweigh liabilities? Possible limitations and benefits of government regulation. (In the short run; in the long run?) Does solution-by-regulation work? (What criteria is used to define "work"; what trade-offs are considered in relationship to what values, etc.?) Legislative intent versus the reality of implementation. Possible changes in attitude of citizens after regulations have "solved" the problem.

2. History Classes: Growth of Federal government involvement. Changes in government and citizen reaction in dealing with problems in different periods of history. (example: comparing similarities and differences between the responses to meat packing regulations during Teddy Roosevelt's administration and that of toxic substances.) Possible reasons for different responses. How has land been used historically? (example: expectations of limitless resources, etc.)

3. Geography Classes: Where are dump sites located? What physical features of the environment must be taken into consideration when a site is considered? What social or cultural factors enter into such decisions? What kind of transportation network does it take to support RCRA and long distance hauling? Who decides what routes should be taken? What kinds of safety precautions are used for the people? For the land itself? How will selection of a site for a dump change the site itself?

ACKNOWLEDGEMNTS

This revised and edited version was originally developed and evaluated by Hilda Morano, a faculty member at Tuchahoe Middle School, Richmond, Va.

ADDITIONAL NOTES

Decision-Making: A Simulation

MAJOR PURPOSES

*To understand and appreciate the methods of decision-making used by businesses and individuals
*To appreciate the importance of having insights about toxic substances and hazardous wastes when making decisions as individuals or private or corporate citizens.

RELATED CONCEPTS/UNDERSTANDINGS/QUESTIONS/SKILLS

*To develop insights about the operation of certain economic principles
*To recognize the importance of identifying possible short and long-term hidden costs in terms of economics and other values of society
*To develop the skills of effective group participation and activity
*To be able to identify the values and attitudes of various segments of society
*To practice distinguishing fact from opinion
*To develop an expanded vocabulary

INSTRUCTIONAL APPROACH

This project consists of two lessons. The first uses primarily a lecture approach and is intended to prepare students for the second lesson which involves a simulation. One class period is devoted to the lecture and two periods are given to the simulation. Details and suggested hand-outs are provided for each.

OVERVIEW

Some students are like that ol' Missouri mule -- reputed to be the best plowpuller in the state -- who refused to budge until firmly struck with a two-by-four, smack between the eyes. "First," the farmer said, "you have get his attention!"

These two lessons have proven successful in getting students' attention. Students will be confronted with value conflicts that require information about toxic substances in making decisions about the trade-offs (possible cost/effect consequences) involved. The dangers of complacency and taking our life-styles for granted are made salient.

Although developed for and tested in a course that stressed economics, the project also could be used in civics, American history, and law studies. Students of both low and high ability levels have responded enthusiastically to the project.

SUGGESTIONS

The opening activity (lecture) should begin with some item with which the students will identify. Records or tapes might be a good example to use, since students in middle schools are usually interested in music and complain about the high price of these items.

The following are suggestions for running the simulation. For large classes several groups will be working at the same time. You will need to provide enough space for each group to remain separated from the other groups so one group's decisions will not affect another's. Reassure your students that they are free to make their own group decisions. Many students are afraid to speak out for fear of being "wrong" and they need to be assured that their decisions are as valid as another's. The debriefing is the critical period when students will come together and share their experiences with the other groups. It is important that students feel free to express opinions and make decisions freely. They should realize that they are not expected to give **THAT** right answer. Be sure to take notes quietly during the simulation, so you will have comments to use to spark discussion in the debriefing. To reinforce concepts learned during the simulation, write key phrases and words on the board as the students discuss their experiences. A written assignment can also be used to reinforce the concepts learned. For instance, students could relate their simulation experiences to the Love Canal reading used with the lecture.

LESSON I

CAN WE STOP POISONING AMERICA?

Time: one class period, plus homework

Activities: lecture, reading, writing -- homework assignment

The lecture (outline provided) reviews the business decision-making process. Introduced early in the economics study was the concept that -- all other things being equal -- businesses make decisions (like individuals) which will benefit them most for the least possible expenditure of capital. Students, therefore, only need a few moments of review. Of course, this lecture can be adapted for use as an introduction to the study of business decision-making by altering the emphasis from review to introduction of concepts.

The lecture emphasized a hypothetical company (Golden Circle Manufacturing Company) which will be used later in the simulation. In doing so, students have the advantage of working with a concrete example in considering the reactions of businesses and individuals to a different situation. At the same time they are receiving information which will be used in the simulation, although they will be unaware of the pending simulation at this point in the project.

LECTURE OUTLINE

I. Introduction

- A. Lead-in: use a product familiar to students which is made of plastic such as a toy or plastic container.
    - 1. Describe composition, manufacturing techniques, manufacturer, location of manufacturer, etc.
    - 2. Discuss uses of product, possible alternative products.
- B. Why was the product made?
    - 1. Was a market created or did one exist for the product?
    - 2. Is there competition? From whom? Can it be overcome?

II. Business organization

- A. What kind of business is this?
    - 1. Large corporation? Owned by conglomerate? Who accepts ultimate responsibility for corporate decisions?
    - 2. Is this company typical of other similar companies?
        - a. Listed on a stock exchange?
        - b. Board of Directors?
        - c. Part of larger corporation?
- B. Government involvement?

    1. In regulating?

    2. As consumer?

III. Pricing factors

  A. Production

  B. Distribution

  C. Hidden (Spillover) Costs

    1. Pollution of water and air

    2. Possible toxic waste from processing

      a. What is toxic waste?

      b. Who pays for disposal?

      c. Who decides where and how disposed?

CAN WE STOP POISONING AMERICA?

(Based on Michael H. Brown's article in the New York Times Magazine, January 21, 1979)

The tragedy of Love Canal began in the 1940s when Hooker Chemicals and Plastics Corp., now part of Occidental Petroleum, began dumping thousands of 55-gallon drums containing a variety of chemical compounds into a canal located in the city of Niagara Falls, New York. The canal was full by 1953 and was simply filled over with bulldozed dirt. The land was sold to the Niagara Falls Board of Education for the construction of a school for the token price of $1.00. However, disregarding the deed which specified only the construction of a school and playground, the city built modest single-family dwellings on the surrounding land.

In a few years there began to appear occasional signs of trouble -- earth collapsing where drums had rotted through; pools of liquid began oozing from the ground. By 1976 the problem became more apparent when pools of **caustic sludge** began gushing from several locations. Children often played with "fire rocks", **phosphorous** chunks that would explode brilliantly when they were thrown against concrete. Children and dogs who often used the playground began suffering from skin rashes. Residents called the area the "Black Lagoon" and reported their children often played in the area despite lack of information as to the nature of the liquids oozing from the ground.

By spring of 1978 many of the homes were **deteriorating** rapidly and were found to be **infiltrated** by **toxic** chemicals that had seeped into the basements. Residents who had formed a community action group pressured the New York State Health Department into a study of the area. The health department found startling health problems in the people who lived there -- i.e., high rates of birth defects, liver disease, and possible cancers.

After increased pressure was brought on the state and federal authorities by the citizens group, President Carter declared the area a federal emergency in August, 1978. Residents in the areas surrounding the Love Canal were evacuated and their homes bought up by the federal government. Several hundred families were relocated away from the Canal.

But the problem is not confined to Niagara Falls, New York. Of the thousands of covered land fills suspected of containing toxic substances in the United States, the Environmental Protection Agency says it estimates that more than 800 are, or could become, serious health hazards.

Indiscriminate dumping has been a national way of life. Though American manufacturers of plastics, **pesticides**, **herbicides** and other potentially toxic products are finally being forced to deposit their chemical wastes in closely regulated dumpsites, the common practice of the past which was to dispose of residues and then forget them, continues to create potential hazards. These dumping practices have resulted in numerous **orphaned dumps** which are still being located and inspected.

The greatest threat the public faces from this toxic waste dumping is in the nation's water supply. About half of the American people depend on ground water -- that is, springs and wells -- as their source of drinking water. For instance, 91% of Florida's citizens are dependent on ground water. Toxic chemical landfills never lie **dormant** if water penetrates them. The water absorbs **soluble** components, producing a polluted liquid called **leachate**, which escapes from the dump. This process can continue for a hundred years. The EPA estimates that the leachate which can be produced by a 17-acre landfill would exceed 4 million gallons of leachate if there were only 10 inches of rain per year!

The federal government has been working since 1976 to provide for **hazardous** waste dumping controls. There is no such thing as a totally secure, leak-proof landfill. The art is new and no one issues guarantees. However, disposal methods are improving. Pits are now lined with special plastics, built on clay-based soil (which **retards seepage**), equipped with special monitoring equipment and inspected to detect leaks which might reach water supplies. Even with these safeguards the possibility of contamination is great. The number of already existing, non-monitored, dump sites is staggering. The EPA estimates that more than 32,000 storage, treatment and disposal sites for hazardous chemicals currently exist in the United States. How many of these are potential Love Canals no one knows. One estimate is that less than 7% of the 92 billion pounds of chemical waste generated each year receives proper disposal.

At the very least, reluctant federal, state and local governments must now face the fact that more than 800 sites have been identified as potential Love Canals. The problem is how to find them and how to pay the enormous costs of cleaning them up -- before more tragedy results.

READING VOCABULARY

The following terms were **highlighted** in the article "Can We Stop Poisoning America?" to make them salient to the student:

caustic sludge: a muddy or slushy deposit of materials which destroys by chemical action

phosphorous: a substance in the nitrogen family that is capable of emitting light, used to change the composition of other chemicals

deteriorating: to become of lesser quality, to decline in condition

infiltrated: to enter into a substance by penetration of the fibers

toxic: relating to poisons, usually unstable, capable of causing physical impairment or death

indiscriminate: without regard to individual merit or need

pesticide: an agent (chemical) used to destroy pests (such as rats)

herbicide: a chemical agent used to destroy plant growth

residue: something that remains after a part is taken

orphaned dumps: disposal sites containing unlabeled chemical substances for which no past owner can be located

dormant: no activity or movement

soluble: capable of being dissolved in a fluid

leachate: a polluted liquid which can seep through the ground to pollute underground water sources

hazardous: involving a danger or risk

retards seepage: slows (or stops) the movement of liquids through to other layers

HOMEWORK QUESTIONS FOR FIRST LESSON

1. Who was responsible for the chemicals dumped at the Love Canal site? Is there some question about how much was known at the time about the possible consequences of such disposal techniques?

2. If the responsible party sold the land to use as a "school and playground" and the board of education allowed homes to be built there, do you think the local government is also responsible for the clean-up? Why or why not?

3. Why do you think evidence of toxic chemicals was ignored from early 1976 to August 1978? What sort of proof would local governments require to initiate mass evacuation?

4. Why have some companies and individuals been dumping hazardous chemicals without regard for the potential danger involved? Do you think people realize the level of danger involved? If not, why not?

5. When these companies are forced to clean up the dump sites, who will pay for the process? Do you think that is right? Who else could pay? Which way is best? Why?

6. Is there a toxic-waste dumpsite in your community or area? If so, where is it located? How many people do you know who are aware of its existence?

LESSON TWO

PLEASANTVILLE, A SIMULATION

Time Frame: two class periods

Materials: handouts
debriefing information
questions

Simulations are motivators; their main "payoff" is the enthusiasm generated by the opportunity to participate in the decision-making, communicating, and growth processes. Simulations help students integrate ideas and concepts into practical applications which, in turn, contributes to a deeper understanding and appreciation of real-life decision-making and communication skills.

This two-day activity is designed to allow students an opportunity to explore their own emotions and values while developing an awareness of how decisions are made in their community which will affect their lives. A critical step in realizing this goal is the debriefing activity. Frequently teachers are disappointed by the apparent lack of learning in a simulation. The actual learning experience occurs after the simulation -- in the debriefing. Debriefing requires students to use their simulation experience to reflect upon their discoveries, their realizations and conclusions. Not only does the debriefing help students synthesize and reinforce their learning, it also provides the teacher an opportunity to assess the success of the endeavor. An analysis of the debriefing experience is provided in a later section of this lesson.

INTRODUCTION TO "PLEASANTVILLE"

Pleasantville is a simulation in which participants are asked to make decisions about industrial growth and the benefits and costs of such growth. Each participant is representative of a group in the community that will be affected by the proposed new factory. Four possible sites exist. Participants must agree on one, if they are to attract the new business needed by the community.

Each participant is given a map, a profile of the character he or she will assume and a short reading about the Golden Circle Manufacturing Company. Each participant must decide individually whether or not to support the company's introduction into the community. If the individual (and therefore the group he represents) agrees to invite the Golden Circle Manufacturing Company to build in the Pleasantville area, he must also decide which site to sell to the company.

The simulation is run in four rounds with new information added after "Round 1" and "Round 3". The entire simulation and debriefing require about 2 hours. If that amount of time does not exist in one continuous block, the simulation should be stopped after "Round 3" and continued the next day. There are eight roles to be played. Several groups can be running in separate simulations in the same classroom.

The teacher's role is one of guide and facilitator. Only as much information and/or rules as absolutely necessary should be given. The teacher must remain outside the participant groups but near enough to take note of conversations for use in the debriefing later.

SIMULATION ROUNDS

Round 1:

Participants are given their character profile, a map of Pleasantville, and a reading about Golden Circle Manufacturing Company (see appendix for examples of handouts). They should be given about three minutes to read and study their assumed characters. Each individual then identifies himself to the group and announces his support or opposition to Golden Circle based on the information provided thus far.

Round 2:

Participants are given a communication from Golden Circle listing the requirements of the company (see appendix). Each participant who supports (at this point most will be in full support) Golden Circle will have to individually decide which of the four possible sites shown on the Pleasantville map will be suitable for the Golden Circle plant. These sites will be based on the individual's assumed character and answers will vary.

Round 3:

Participants will form into a town meeting-like setting and each person will have 2-3 minutes to express his opinion on the best site. The mayor will take charge of the meeting and will see that everyone has been heard. Once everyone has been heard and all the supporting and opposing views have been considered, a vote should be taken on which site to propose to Golden Circle.

Round 4:

Participants are given a copy of a news article which reports that Golden Circle is being indicted in other areas for allegedly mishandling toxic chemicals produced by the company (see appendix). The article includes the company's denial of any wrongdoing. The group must now decide whether to reconsider its decision to invite Golden Circle into the community. The group should then compose a letter to be sent to the Golden Circle Manufacturing company either inviting it to come to Pleasantville or rejecting the new plant. If the decision is to reject the plant the letter should include reasons for the rejection. The round ends when the letter has been composed.

Teacher's Instructions:

Round 1: Give out materials to groups and explain that they will be assuming the character they have been given and that all decisions should be made with that character in mind. Tell the students to study their materials and introduce themselves to each other.

Round 2: Give each participant a copy of the requirements from Golden Circle and have each participant study them for a few minutes. Tell each participant to make a decision about where to locate the plant.

Round 3: Help the group to form a town meeting-like group with the mayor as leader. Explain that each person will have 2-3 minutes to express his support or opposition to the proposed plant. The mayor should be in charge of the group. Take no part in the discussion except to help the Mayor keep the discussion moving if necessary. Tell the participants they will be taking a vote at the end of the discussion.

Round 4: Give each participant a copy of the news article and explain to the groups that they should read and consider the new information. The group should decide by majority vote whether or not to invite Golden Circle into the community. Instruct each group in writing a communication to Golden Circle.

DEBRIEFING

Teachers continue to search for teaching techniques which can motivate students to learn. Simulations are receiving increased attention as a viable approach to overcome student apathy. However, in many cases teachers are disappointed with the lack of learning that is demonstrated by students after experiencing a simulation. All too often this occurs not as a result of some fault in the simulation but because of the teacher's lack of knowledge about where and how learning from a simulation occurs. The game experience offers little opportunity for real learning. It is after all, just an experience. It is when the student is given the opportunity to look at the experience and come to grips with what happened to him and his classmates that the actual learning occurs.

The real learning from any simulation occurs in the post-game debriefing discussion. The intense involvement experienced by most students during the simulation precludes any objective reflection during the activity. Only after the simulation has been completed can the teacher assess student learning. The heart of the simulation is the debriefing/learning experience. It is, therefore, of paramount importance that the teacher understand effective debriefing techniques.

EIAG Model Debriefing

One of the most effective debriefing techniques is the EIAG model:

Experience: "Do" -- explain the game experience.

Identify: "Look" -- be descriptive.

Analyze: "Think" -- be analytical.

Generalize: "Learn" -- draw conclusions.

By following such a model the teacher may be more successful with simulations as an instruction strategy. However, the teacher must remain aware that this is simply a model which must be adapted to fit the individual situation. The teacher must create a non-threatening environment which allows the students to discuss freely their feelings and emotions. In most cases the students are anxious to discuss what happened and the teacher needs only to keep the discussion focused and moving.

Pleasantville Debriefing

Here are some examples of debriefing questions using the EIAG model:

1. Experience: Who were you? How did you assume your character? What aspects of the character influenced your decisions?

2. Identify: What were you trying to do? What was the most significant thing to you? Why?

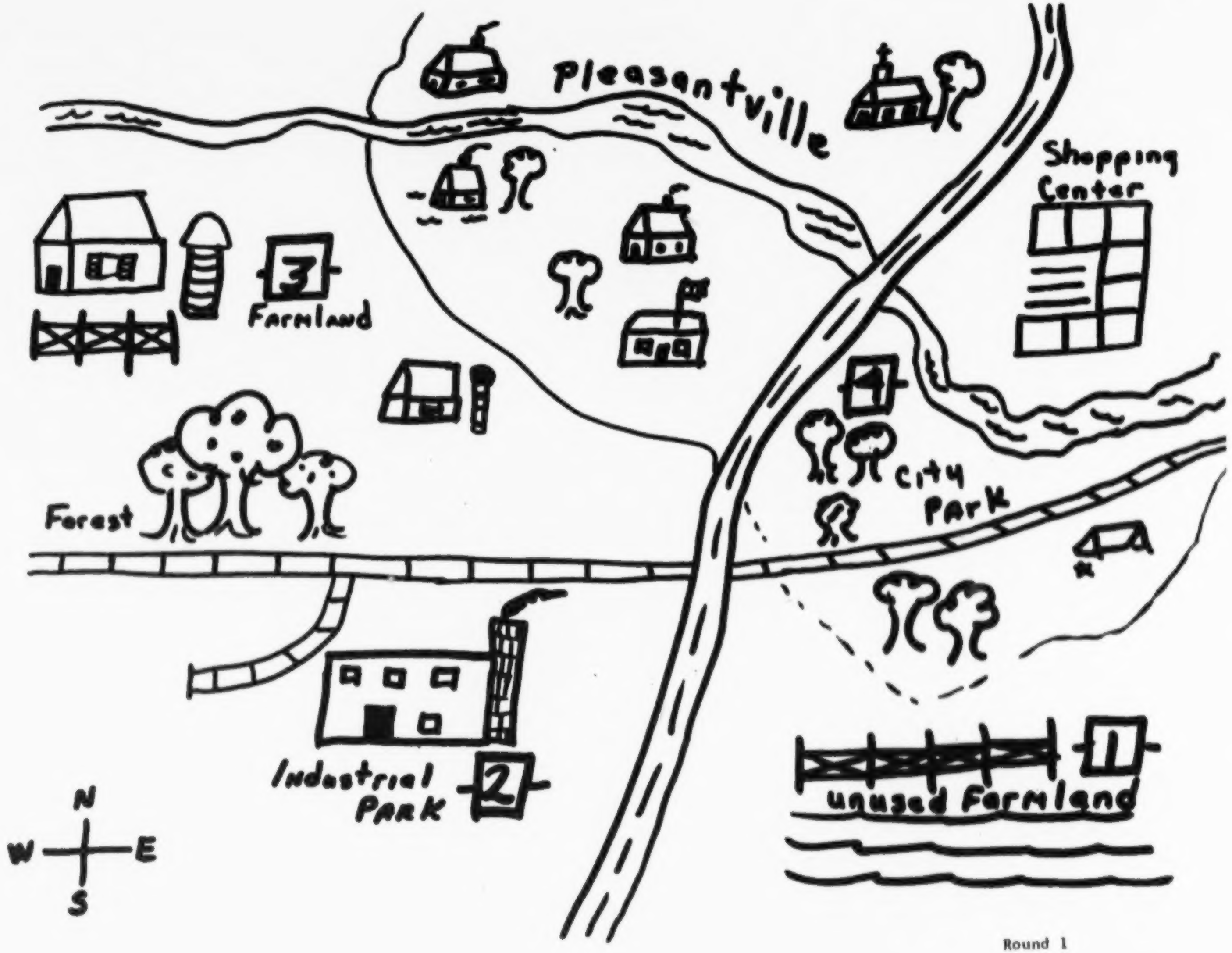
3. Analyze: How did you meet problems? Do you see any relationships between characters and actions? Why did certain events occur?

4. Generalize: Did you learn something from this experience? Can you draw any conclusions about how businesses and individuals act?

ACKNOWLEDGMENTS

This revised and edited version was originally developed and evaluated by Janice Westbrook, Community High School, Richmond, Va.

NOTES


Pleasantville
Shopping Center
3
Farmland
4
City Park
Forest
Industrial Park
2
1
unused Farmland
N
W
E
S

Round 1

PROJECT APPENDIX

The handouts on this and the following pages can be reproduced or modified for the simulation, "Pleasantville". Each "profile" should be cut out and a copy given to the appropriate participants. Of course, all participants should receive a copy of "Pleasantville" and "Golden Circle Manufacturing Company".

HANDOUTS FOR ROUND 1

PLEASANTVILLE

Pleasantville is the county seat which means residents of a larger area are involved in the government. Pleasantville is a suburban community of about 25,000 people, located in a transition area for a large city (located about 20 miles north) yet borders farm land and forests. The industrial park was built about five years ago and attracted several companies from the larger city. Recent economic hard times, however, have resulted in closed factories and increased unemployment in Pleasantville.

Pleasantville is eager to attract new business to revitalize the community. Residents and neighbors boast of the low crime rate, and good climate and housing, but everyone is especially proud of the new 1500 acre park and campground overlooking the river. The Chamber of Commerce points to the large, trained work force available, the easy access to water, road, and rail transportation, and the already existing plant facilities in the industrial park.

GOLDEN CIRCLE MANUFACTURING

Golden Circle Manufacturing is a nation-wide conglomerate specializing in the production of plastics and chemical compounds used in toys, automobiles, and military equipment.

The Golden Circle Manufacturing Company is currently seeking to expand its operations into new areas. A Golden Circle Manufacturing plant in your area would mean 500 new jobs for your community. In addition, many other companies would follow Golden Circle into new territory, so a Golden Circle plant in your area would mean additional jobs and tax revenues.

Golden Circle believes in supporting its communities over and above the thousands of dollars it pays in local taxes. Golden Circle employees are encouraged to live and shop in the host community. Money paid in wages is spent in the community which benefits the local businesses.

CHARACTER PROFILE

Mayor

You have been mayor for about 10 years, a member of the Chamber of Commerce, work as an insurance agent, and are married with three children (19-year old son in need of job to help finance college; twin daughters, age 14, who attend the local middle school). Your family is active in the local community; your wife organized a citizen group which successfully lobbied for the new park on the river. Your hobbies are fishing and camping. You, as mayor, want DESPERATELY to revitalize the community. You have actively sought to attract new business to the area which has resulted in the interest expressed by Golden Circle.

CHARACTER PROFILE

Member, Board of Supervisors

You live in the inner-city area of Pleasantville -- an area of high unemployment. You are also affected by the closing of the factories in the industrial park, because you own the grocery store located in the shopping center, and your business has suffered.

You are married with two boys (age 4 and 8), the older boy attends elementary school across the highway from the new park. You have been supervisor for only one year and doing something about the empty factories is "high on the list of things to do".

CHARACTER PROFILE

Member, Board of Supervisors

You are a farmer who owns the large dairy farm west of Pleasantville on the river. The farm has been in the family for 100 years. You are most interested in maintaining the farming atmosphere of the area. Depressed economy has hurt the dairy's sales, but you are undecided about the value of industrial growth in the area. You actively supported the citizens group in building the new park.

You are married but your children are all grown and living away from home. It is your hope that your youngest son will return to take over the farm when he finishes college.

CHARACTER PROFILE

Factory Supplier

You own an industrial supply company located in the industrial park. The closed factories have meant lost business to you. You want to get the factories re-opened or new businesses started. You have been pressuring the mayor to attract new business quickly. You are single with no children, but the many debts accumulated in starting your company are pressing you. If business doesn't improve soon, you will be forced to declare bankruptcy.

You enjoy camping but haven't tried the new park yet.

CHARACTER PROFILE

Small Farmer

You are a small farmer depending on the sale of vegetables and produce in the community market. You fear continued hard times will result in the loss of your farm.

You are married with four children. The farm is located at the southern end of town near the new park where children play after school. Your wife works part-time at a store in the shopping center, but may lose her job if business doesn't pick up.

CHARACTER PROFILE

Homeowner

You are the widowed mother of two. You own good property near the highway, overlooking the river. You want to keep the property as insurance for your sons' college education (they are ages 16 and 17 now). You are active in church and community affairs. Your husband left you with adequate insurance, but hard times have deprived sons of part-time jobs in the factory. You fear the boys will not return to Pleasantville after they finish college because they will not be able to get jobs. The value of your home will also decrease if people leave the area.

CHARACTER PROFILE

Environmentalist

You teach at the university in the larger city to the north. You have lived in Pleasantville all your life. You are active in community affairs -- served as advisor to committee which planned and built the new park. You live near the river in the western part of Pleasantville. You are married with two children. Your husband owns the shopping center across the river from the park. You are very interested in protecting the natural environment. You are considered an expert in air pollution. You opposed the building of the industrial park as a possible source of pollution.

CHARACTER PROFILE

Unemployed Factory Worker

Your factory laid you off about six months ago when the plant closed down. You have been unable to find another job and your unemployment benefits expire in 60 days. You support one child and an invalid mother. You are currently living in the new park in a camping trailer. The city council may decide to make a position available as campground supervisor, and you hope to get that job.

HANDOUT FOR ROUND 2

All students should receive copies of the following handout:

GOLDEN CIRCLE REQUIREMENTS

Now that your community is seriously considering an invitation to Golden Circle to locate in your area, you should know that the following are required by Golden Circle:

1. A trained workforce of at least 500 people.
2. Access to a highway, a railroad, and a river.
3. Approximately 1,000 acres of land for plant and support facilities.
4. Community with local laws permitting movement of chemicals.

HANDOUT FOR ROUND 4

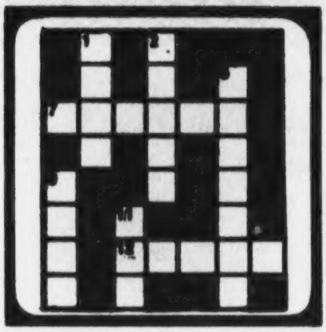
CHEMICAL COMPANY INDICTED

AP Wire Service: Golden Circle Manufacturing Company has recently been under investigation for allegedly mishandling hazardous chemicals manufactured by the company. According to the indictment handed down today by the Grand Jury, several Golden Circle plants have been illegally dumping toxic chemicals used in the manufacturing process, resulting in the possible closing of the river. These chemicals were reportedly illegally dumped in the local river over a period of several years and in other cases, hazardous chemicals were transported in unmarked containers through several towns and left at a local trash dump. The chemicals the company illegally handled allegedly included the deadly compound, Dioxin.

A spokesman for Golden Circle denied all charges. The spokesman said the company did transport and manufacture toxic substances, but stressed that Golden Circle always took proper precautions and again denied all allegations.

ADDITIONAL NOTES

Vocabulary Reinforcement Exercises: Crosswords, Word Codings, and Seek and Find



MAJOR PURPOSES

*To provide several exercises using words and terms associated with toxic substances and hazardous wastes

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS/QUESTIONS

*To improve word recognition and spelling
*To provide word reinforcement via several puzzle-type word games
*To provide a change of pace or individualized word game for use at the student's leisure
*To assist in terminology and definition development

INSTRUCTIONAL APPROACH

Teachers may use these word games as activities to reinforce vocabulary, at a time when review is necessary or when the teacher needs a "time filler," such as after a test. It should be obvious that these word games have a somewhat limited educational value but they could serve to challenge the student as a change of pace or a break from the norm. The answers are included and teachers may want to encourage students to write their own questions and construct a similar puzzle. Please note that there is substantial overlap in the terms used in the first three word games. Also note that additional clues can be given to the students depending upon their ability levels.

The games are on individual pages so direct reproduction is possible.

OVERVIEW

There are three activities included that contain vocabulary and short questions that may be used during or after a unit on toxic substances and hazardous wastes has been undertaken. The activities include:

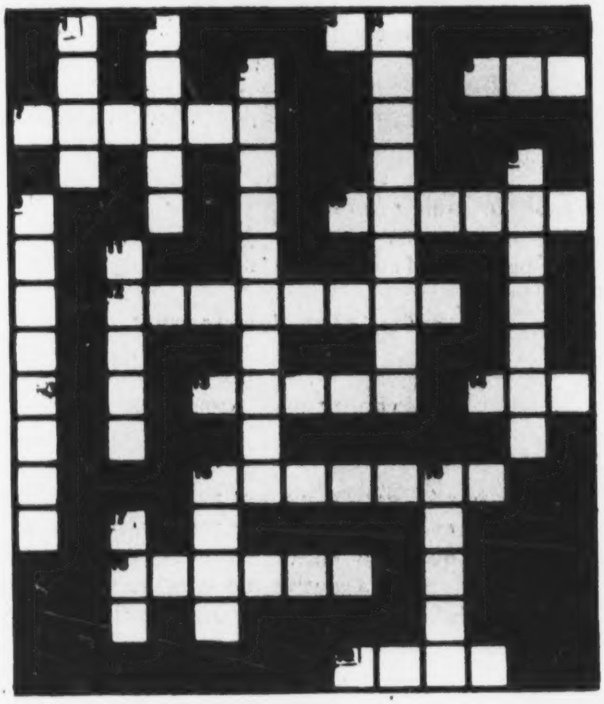
*Crossword Puzzle with 19 words

*Word Coding Exercise where students have short questions requiring a one-word answer or they are asked to identify a term. The resultant answer provides a letter to the code word which answers the overall question asked.

*A second word coding exercise.

*A Seek and Find Exercise where hidden words relating to toxic substances and hazardous wastes are included in a box of random, disguised letters. Students are asked to find specified words that may run forward, backward, up, down or diagonally. Words are circled when found.

VOCABULARY CROSSWORDS



ACROSS

3. Acidity scale
6. Polychlorinated biphenyls (abbr.)
7. Toxin in Agent Orange
10. Abandoned dump site
12. Fiberous mineral
13. River polluted by kepone
14. Petroleum
15. To use again
18. Containing tiny holes
19. Occupational Safety & Health Act (abbr.)

DOWN

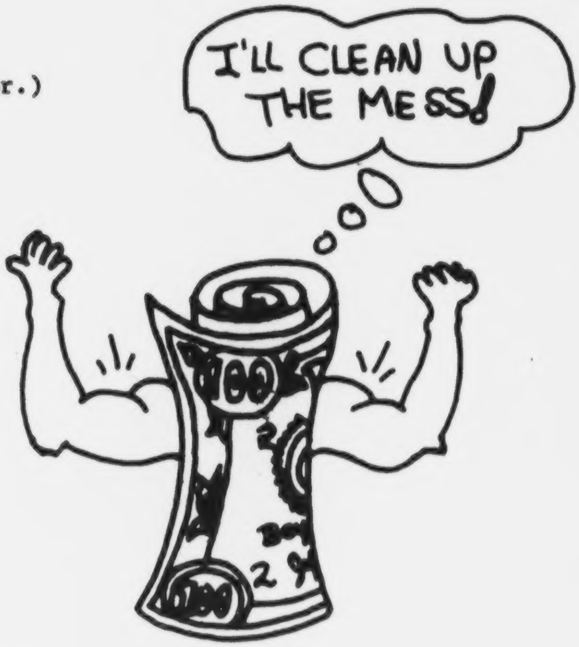
1. Toxic rain
2. Poisonous, causes health problems
4. Risky, dangerous
5. To burn waste
8. Action of a base
9. Papers that follow transported waste
11. Useless, discarded material
15. Resource Conservation & Recovery Act (abbr.)
16. To filter through
17. Environmental Protection Agency (abbr.)

WHAT AM I??????

Instructions: What government project is responsible for the clean-up of abandoned dump sites. Find the words that answer the clues to find out who our muscular friend is.

CLUES

1. Useless matter, discarded material
2. Risky, dangerous
3. Environmental Protection Agency (abbr.)
4. Fiberous mineral
5. Abandoned landfill
6. Where wastes are buried
7. Action of a base
8. Toxic substance in Agent Orange
9. Hazardous rainfall


I'LL CLEAN UP THE MESS!
100
100

1_ _ ☐ _ _

2_ _ _ _ _ _ _ ☐ _

3_ ☐ _

4_ _ _ ☐ _ _ _ _

5_ ☐ _ _ _ _

6_ _ _ _ ☐ _ _ _

7_ _ ☐ _ _ _ _

8_ _ _ _ _ ☐

9_ _ _ ☐

WHAT'S LEAKING???????

Instructions:
This leaking container needs to be cleaned up. But how? The container is unlabeled and therefore, potentially dangerous. Can you help identify the contents?

CLUES

1. Toxic substance found in the James River in VA
2. Section of a landfill
3. __________ to grave
4. Agent __________
5. Waste from smoke stacks
6. Resource Conservation and ____________ Act
7. Acid ________
8. Fiberous mineral

☐ E _ _ _ _

_ ☐ L _

_ ☐ _ D _ _

☐ R _ _ _ _

F _ _ _ ☐ _

_ ☐ _ _ V _ _ _

_ A _ ☐

_ S _ ☐ _ _ _ _

SEEK AND FIND THE WORDS - TOXIC SUBSTANCES & HAZARDOUS WASTES

Instructions: Hidden words listed on the left appear forward, backward, up, down or diagonally. Find each word and circle it. Record the length of time necessary to complete the exercise.

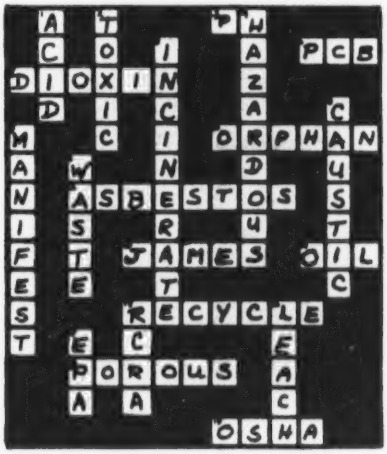
WORDS

- Barrels
- Cats
- Chemical
- Chickens
- Congress
- Contaminated
- Dangerous
- Dioxin
- Disposal
- Dogs
- Doomsday
- EPA
- Flood
- Fridley
- Guidelines
- Hazardous
- Horses
- Inhaling
- Lagoon
- Meramec River
- Michigan
- Missouri
- Moscow Mills
- New Jersey
- Officials
- Poisonous
- Respirators
- Sample
- Site
- Superfund
- Technicians
- Toxic
- Toxins
- Wastes

W	A	S	T	E	S	C	N	T	M	S	G	O	D	S
S	U	O	N	O	S	I	O	P	E	P	A	P	O	A
D	I	S	P	O	S	A	L	T	R	N	E	L	O	M
T	C	U	B	U	N	G	O	C	A	T	S	F	M	P
K	C	O	N	G	R	E	S	S	M	S	P	R	S	L
H	O	R	S	E	S	T	N	C	E	E	L	I	D	E
L	E	E	T	D	S	I	T	E	C	T	A	D	A	S
W	X	G	K	O	X	N	T	B	R	S	G	L	Y	C
S	C	N	T	O	X	I	C	N	I	A	O	E	T	P
B	K	A	I	L	T	W	O	G	V	W	O	Y	C	N
O	T	D	B	F	U	N	C	H	E	M	N	O	T	C
S	A	M	P	L	S	L	E	R	R	A	B	I	D	N
C	H	E	M	I	C	A	L	T	O	P	M	N	E	S
V	A	T	M	I	S	S	O	U	R	I	I	H	T	N
O	F	F	I	C	I	A	L	S	B	J	C	A	A	A
T	O	N	T	O	X	I	N	S	C	B	H	L	N	I
G	U	I	D	E	L	I	N	E	S	S	I	I	I	C
S	R	O	T	A	R	I	P	S	E	R	G	N	M	I
S	N	E	K	C	I	H	C	P	C	B	A	G	A	N
N	E	W	J	E	R	S	E	Y	O	T	N	O	T	H
H	A	Z	A	R	D	O	U	S	L	O	P	E	N	C
B	S	U	P	E	R	F	U	N	D	C	N	T	O	E
M	O	S	C	O	W	M	I	L	L	S	I	C	C	T

KEYS/ANSWERS/SOLUTIONS

VOCABULARY CROSSWORDS


ACID
TOXIC
PH
HAZARDOUS
PCB
DIOXIN
INCINERATE
CAUSTIC
ORPHAN
MANIFEST
WASTE
ASBESTOS
JAMES
OIL
RECYCLE
EPA
RCRA
LEACH
POROUS
OSHA

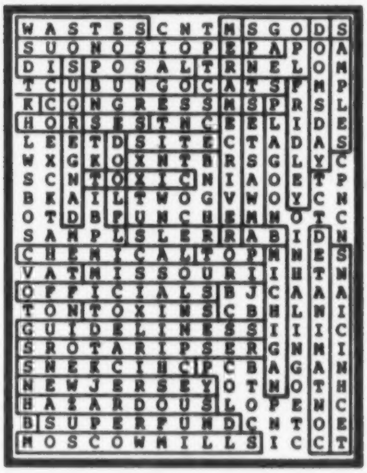
WHAT AM I???

1 WASTE
2 HAZARDOUS
3 EPA
4 ASBESTOS
5 ORPHAN
6 LANDFILL
7 CAUSTIC
8 DIOXIN
9 ACID

WHAT´S LEAKING???

KEPONE
CELL
CRADLE
ORANGE
FLYASH
RECOVERY
RAIN
ASBESTOS

SEEK AND FIND THE WORDS



W A S T E S C N T M S G O D S
S U O N O S I O P E P A P O A
D I S P O S A L T R N E L O M
T C U B U N G O C A T S F M P
K C O N G R E S S M S P R S L
H O R S E S T N C E E L I D E
L E E T D S I T E C T A D A S
W X G K O X N T N R S G L Y C
S C N T O X I C N I A O E T P
B K A I L T W O G V W O Y C N
O T D B P U N C H E M M O T C
S A M P L S L E R R A B I D N
C H E M I C A L T O P M N E S
V A T M I S S O U R I I H T M
O F F I C I A L S B J C A A A
T O N T O X I N S C B H L N I
G U I D E L I N E S S I I I C
S R O T A R I P S E R G N M I
S N E K C I H C P C B A G A N
N E W J E R S E Y O T N O T H
H A Z A R D O U S L O P E N C
B S U P E R F U N D C N T O E
M O S C O W H I L L S I C C T

ACKNOWLEDGMENTS

This edited version was originally prepared and evaluated by Willard W. Wilson, Jr., a faculty member at Mosby Middle School, Richmond, VA and by Elaine P. Woodard, Powhatan Middle School, Powhatan, VA. Mrs. Woodard developed the Seek and Find puzzle. Mr. Wilson is responsible for developing and testing the first three word puzzles.

Reading Skills, Media, And Citizenship

MAJOR PURPOSES

*To increase interest in following current issues in the newspaper
*To develop awareness about the problem of subjectivity and objectivity in reporting and thus the importance of critical reading
*To apply and refine the skills of critical reading
*To increase awareness about the problem of toxic substances
*To refine the skills of developing defensible conclusions and generalizations

RELATED CONCEPTS/UNDERSTANDINGS/QUESTIONS/SKILLS

*To develop a larger vocabulary
*To refine listening skills
*To work on skills of brainstorming

INSTRUCTIONAL APPROACH

The approach uses a newspaper article (provided), point-of-view worksheet (provided), and dictionaries to have students (1) read for information, (2) infer or "read between the lines", and (3) form educated opinions. It will usually take one-and-half to two days to carry out this activity in its entirety.

OVERVIEW

Because of its dramatic emergence, the toxic substances and hazardous wastes issue is receiving ever-increasing media attention. This, combined with the potentially emotional and controversial nature of the issue, provides an excellent opportunity to develop insights into media coverage and appropriate reading skills.

These insights and skills are obviously important for students to develop, if they are to function as responsible citizens. Students should be aware of the contributions, responsibilities, and problems of media coverage as well as the responsibilities of the reader.

This project uses the newspaper for the case study, because it is a relatively inexpensive and generally accessible resource that abounds with articles about toxic substances.

Using the newspaper to examine an issue critically supports the paper as a legitimate source of information, if both the paper and the reader meet their responsibilities. Objectivity in reporting is certainly one of these responsibilities and one which presents a challenging problem for the reader and paper alike. It requires constant vigilance from all parties to monitor this responsibility. Important to meeting this obligation is recognizing such things as the distinction between reporting and editorializing, the role of reporters and editors in deciding how and what is reported, and how words can carry different meanings. This project provides an opportunity to consider these and other points related to media coverage.

ACTIVITIES

The activities of this project can be divided into three parts:

1. Reading an Article at Face Value
2. Reading Between the Lines
3. Forming an Educated Opinion

ACTIVITY I

Reading An Article At Face Value

1. Teacher-led discussion about the necessity of reading the paper.
   Some suggested questions for leading the discussion:
   - Why do people read the paper?
   - What would you miss if you could not read the paper?
   - Could it be dangerous to read the paper? (knee-jerk responses, etc.)

2. Ask: To be able to react responsibly to a news item, what things do you need to know?
   Some possible answers:
   - What the words mean, the vocabulary.
   - Why the article was written. (Is it an editorial? A news item?)

   At this point the difference between editorializing and reporting should be established. Students should also start realizing that careful attention to vocabulary or semantics is essential to understanding.

3. Pass out copies of the article: "Bill Would Allow Virginia to Dictate Dump Sites." (See the Appendix of this project for a copy of the article)

4. Have students read the article silently for their general impressions. This is the first of several readings, each of which becomes progressively more critical.

5. Direct students to re-read. This time they will underline all unknown words as they go.

6. Have students put the article away. Now, have them write the most thorough summary possible. (This summary will be used for comparison with a later one. The teacher may wish to collect these or to let the students keep them in the notebook.)

7. Elicit all vocabulary words and put them on the board. As a class, give meanings to as many words as possible from contextual clues. Use a dictionary only when necessary. (Do not get bogged down with definitions. Brevity and simplicity are the key. After all, how many people use a dictionary when reading the Sunday paper?)

Significant words and terms to cover:

state agency
hazardous
waste
disposal
bill
locality
doctrine of eminent domain
negotiate
legislation
commercial
firms
blanch
sitting
technically

8. After a discussion of vocabulary, have students re-read the whole article.

9. Have them write another summary. (You may wish to collect.)

10. Briefly discuss the differences, if any, between the two summaries each student has written. (Vocabulary knowledge should have increased understanding quite a bit.)

ACTIVITY II

Reading Between The Lines

The steps in this activity are intended to make students aware of considerations that inexperienced or untrained eyes might overlook, such as decisions made by the reporter and editor that could influence readers without their knowing it.

11. Put these three statements on the board:

> The bill would allow the state to dictate where a hazardous waste facility is established.

The bill would allow the state to locate hazardous wastes in designated localities.

The bill would allow the state to force an unwilling locality to accept a dump.

Ask: What is the difference between these three statements?
Is one more objective than the others?
Is one less provocative than the others?
Which one would you choose to describe the situation as you understand it at this point and why?

12. Ask the class to find some examples of statements likely to be facts. Then have them locate some opinions.

13. Explain that we can't tell the difference in many cases. Paragraph #8 is a good example.

14. Ask: Where could you go to check the facts? Go back to the student examples and answer.

15. Ask students to find any emotion-provoking words in the article. Discuss whether such reporting should try to avoid provocative words? Example: Would the use of "landfill" or hazardous waste facility be more accurate, less provocative than using "dump"?

Discuss words that might have been used in place of these words. Are there other ways of saying the same thing? For example in paragraph #8: "But when..., the county objected and the state withdrew its proposal."

How is the rewritten version different from the original?

16. Ask: What is the purpose of a headline? Is the headline appropriate? Why? Can you make up another headline that is more appropriate?

17. Ask: Where do you think the reporter got the information with which to write the article? Who, if anyone, was probably interviewed?

18. Have students do the point-of-view worksheet. (See Appendix of this project for the worksheet) This makes a good homework assignment.

19. Have students respond in class to the point-of-view worksheet.

20. Elicit: What are the conditions under which a reporter works? How might these affect a news article?

Examples:

- Copy space may need to be filled, therefore a longer article might be needed.
- The paper may be short on space one day.
- An editor might think it worthy of the front page -- or the last. Which articles are you most likely to read?
- There may be a sudden deadline to meet.
- They need interesting and newsworthy stories to sell papers.
- Could there be a conflict of interest between the story and, say, commercial or other interest of the publisher?
- What are the reporter's personal feelings about the issue?
- Does the reporter think that the public wants something reported in a certain way?

These examples represent some of the concerns and problems which journalists confront from time to time. Reputable journalists constantly monitor the way such situations are addressed to protect their professional integrity. It is important, however, that the public is aware of them, so that they can read critically and thus provide an external check on any possible abuses. Students should be aware that "reading critically" suggests a positive form of questioning or vigilance rather than negative one.

21. Discuss the meaning of the phrase "reading between the lines".

ACTIVITY III

Forming An Educated Opinion

In this phase students will reflect on the implications of the preceding activities to draw conclusions about the role of newspapers, specifically, and media, generally, in their keeping informed and exercising civic responsibility.

22. As a focal point for their reflection and discussion, put on the board the following quote by Thomas Jefferson:

> "Eternal vigilance is the price of liberty."

23. Ask if anyone can explain what this quote has to do with the activities in which they have been engaged. Ask them to use the approach practiced earlier; that is, clarifying the meaning of any words not part of their vocabulary.

As previously (Step 7), provide contextual clues (historical setting, word associations, etc.) about the quote so that the class can deduce the meaning of individual terms and the quote. This will reinforce the process introduced earlier and possibly add several more words to the students' vocabulary -- one of the objectives of this project.

24. See if they can think of another way of expressing the idea. For instance, try to elicit something like "we must always be alert to keep our freedom".

25. Focus attention on "alert" or "vigilance" by asking the students to give from the project's first two activities examples of things to which a responsible citizen should be alert.

> In eliciting responses, stress the importance of specificity by helping the students break down their generalized conclusions. A likely example of such a response is "that a responsible citizen should be alert to what newspapers are reporting". Have them focus on the specific aspects of reporting about which one should be aware.
>
> This emphasis of specificity is important, of course, as part of the skills of critical reading and of drawing defensible conclusions. This should be noted and reinforced whenever possible. It should be pointed out to students that what they are doing in this series of activities is becoming aware of and developing insights and skills that too many adults have not adequately mastered.
>
> Pointing this out has two advantages:
>
> One is that it helps reinforce the value and purposes of the activities. This often results in an enthusiasm about gaining such knowledge and skills.
>
> A second is that it can be used to have the class specify some possible consequences of not having these insights and skills and to reflect upon how those consequences could affect their lives directly. This, naturally, helps reinforce the sense of value noted in the previous point by making it more personal and thus less abstract.

26. Discuss the points that were identified in Step 25 concerning those things about which a responsible citizen should be aware.

The following questions should be helpful in guiding the discussion and drawing conclusions based on the considerations and activities of this project -- that is "Reading at Face Value" and "Reading Between the Lines". Other questions or variations on these may have to be used depending on the class. For emphasis, the questions have been divided into two broad groups:

69

Drawing Conclusions About Responsible Use of Newspapers and Other Media in Following Current Events:

Do you think that events related to toxic substances are important for newspapers to report?

Do you think that newspapers have a responsibility to report on events related to toxic substances? Why?

What responsibilities do they have in reporting the news?

What are some of the factors that affect the reporting of news?

How might these factors affect their responsibilities?

Should citizens be aware of these factors? Why?

Does being aware of these factors help in reading critically?

What other techniques are involved in reading critically?

What are some possible consequences of not reading critically? To society? To themselves?

Drawing Conclusions About the Issues Reported in the Article:

Have one student summarize the article orally.

Ask: What problem in Virginia is indicated by this article?
Answer: Should the state be allowed to site a hazardous waste "dump" in a place where the residents don't want it?

Ask: Should the state be able to locate the site where it wants to?

Ask those who responded "yes" if they would want such a site located near them. How do they think it would affect them?

Ask those who said "no" where the waste should go.
Is it fair to pass it on to another state?
Will industry want to locate in Virginia if it knows it will have to go to the large expense of shipping wastes? What could this do to unemployment?

27. Ask if they see better the dilemma presented by the article. Is it a situation that they think is important to have more information about? Do they think what they have learned in these activities will

help them in following developments about toxic substances in a responsible manner?

EXTENSIONS AND APPLICATIONS

The focus in this project has been on newspapers, but with a little more time and effort, students could weigh the similarities and differences between the reporting of news in the other forms of media. In either social studies or science classes this project would be appropriate for introducing students at the beginning of the year to current events reporting and the skills needed for using the reports responsibly.

From this effort students should be more aware of the need for additional knowledge about both media and toxic substances and the various related issues. At appropriate places during the remainder of the course, the class could add to and refine their insights about both media and the toxic substances and hazardous wastes dilemma.

Both social studies and science teachers will find this project compatible with Virginia's Standard of Learning in social studies (specifically 7.7, 8.1, 8.8, 9.6 - 9.11) and in science (specifically 8.16 - 8.18).

ACKNOWLEDGMENTS

This revised and edited version was originally developed and evaluated by Lynn P. Wilson, faculty member of Varina High School, Richmond, Va.

PROJECT APPENDIX

POINT-OF-VIEW WORKSHEET

Name Date Period

Directions:

Two types of persons are described below who would be very interested in an article on toxic wastes. After reading the article on the following page, your job is to read each description below and become that person in your imagination. Then read the article again. Try to imagine how each type of person would react to the article.

A. You are the president of Good Guy Chemical Company. Each year your company goes to great expense to ship hazardous wastes out of Virginia because there is no place here to deposit it legally. You and other businessmen have been working through the General Assembly to establish a hazardous waste landfill in Virginia.

1. Look up the word "landfill". Write its definition in this space.

2. Do you think the article will help gain public support for your bill? Why or why not?

3. Do you think the author of this article supports your point of view? Why or why not?

4. The word "dump" is used in the article. What is your reaction to this word?

B. You are A. Hippie Lawyer, a vegetarian and a lover of nature who realizes that often landfills leak their toxic substances out into the environment. You have been active in protesting industry before.

1. How does reading the article make you feel? Why?

2. Does the article make you want to sympathize with anyone? If so, who? Business? Unwilling localities? The state? Explain.

Bill would allow Virginia to dictate dump sites

By The Associated Press

The state agency responsible for hazardous waste disposal is circulating a bill that would allow the state to force an unwilling locality to acccept a dump.

The proposed legislation from the Health Department's Solid Waste Commission also would give the locality a chance to negotiate over the dump's location and design.

Businesses that produce hazardous wastes have been calling for such legislation. There is no commercial hazardous waste dump in the state, and Virginia firms that do not have their own disposal facilities must bear the expense of shipping waste out of state.

But some localities are likely to blanch at the thought that the state could override local governments and allow construction of a waste facility where it is not wanted.

The bill would create a Hazardous Waste Facility Siting Board, which would take applications from state agencies or private firms seeking to build disposal facilities.

Local government officials would be able to negotiate with builders for locations and specifications of the facilities. But if the builders negotiate in good faith and their plans meet state and federal guidelines, the board would have the authority to let them build the facility even if the local officials object.

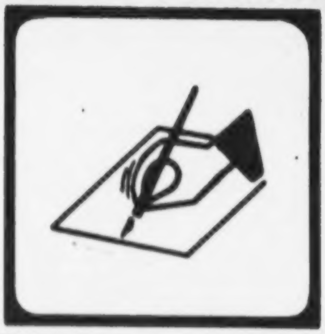
Technically, the state already has the power to obtain land for a waste dump through the doctrine of eminent domain, which allows the state to condemn land when it will serve a public need.

But when the Health Department tried to aid a private firm in establishing a dump in Buckingham County in 1981, the outcry from the county was so fierce that the state scrapped the plans.

The bill is modeled after a proposal from the Toxics Roundtable, a group of Virginia industrial, local government and environmental organizations.

Because the roundtable includes so many interest groups, its bill may fare better than one that was put up for public hearing by the commission in December. After much criticism, that bill was withdrawn.

Cartoons: Developing Analytical And Interpretive Skills



MAJOR PURPOSES

*To use cartoons to increase student awareness of various aspects of the toxic substances issue and to identify and correct misconceptions
*To develop students' skills in analyzing and interpreting cartoons (An expectation included in Virginia's Standards of Learning)

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS/QUESTIONS

*To recognize the various purposes of cartoons
*To understand methods the cartoonist uses to achieve his purposes
*To be able to identify values expressed by the cartoons
*To be able to draw defensible conclusions from the analysis
*To recognize how cartoons can be used to study particular topics or historical periods
*To appreciate the importance of distinguishing fact from opinion

INSTRUCTIONAL APPROACH

Cartoons are used to help students learn to analyze for deeper meaning while becoming aware of various aspects of the toxic substances and hazardous wastes issue. To accomplish this the TSSPP (Title, Symbols, Situation, Purpose, and Point of View) method will be employed. This approach is described under Activity # 1. There are two other activities that can be used in conjunction with the first activity or separately.

OVERVIEW/BACKGROUND

Given the potential impact of cartoons in shaping or reinforcing, possibly subconsciously, points of view, it is easy to see why being able to read or interpret them is listed as one of the expectations in the Virginia Department of Education's Standards of Learning for social studies. Cartoons certainly have proven successful in making students aware of different aspects of the toxic substances problem while helping develop such skills and understanding as those listed above -- all of which are appropriate for practically any social studies course.

For science teachers, cartoons have proven useful in reinforcing and evaluating knowledge by having their students apply previously learned information. Students welcome this approach as an alternative to the traditional homework and tests.

Reading or interpreting cartoons requires the ability to identify symbols that are used, the cartoonist's purpose, and the situation being depicted. The cartoons may make use of exaggeration, oversimplification, caricature, stereotypes, or satire. The cartoonists may be striving to portray a person or event in a positive or negative light by emphasizing features which can quickly convey a meaning. Many well-known symbols -- Uncle Sam, the Republican elephant and the Democratic donkey -- are frequently used to express complex ideas or situations. These symbols often act as keys which unlock the cartoon's meaning.

Cartoons that relate to many aspects of the toxic substances problem can be found in newspapers and magazines. These have become increasingly prevalent in recent years. Some examples are provided with this project. As students become increasingly aware of the issue, they can be expected to add to the collection. This has proven to be a good evaluation of the students' lasting awareness of the topic.

It may be easier for students to interpret and analyze more recent cartoons than older ones. The latter, however, provide an opportunity to inquire into past events and identify similarities and differences between those events and the present.

ACTIVITY # 1

In this activity students will become familiar with the TSSPP approach to analyzing cartoons. This procedure helps students to take any political or editorial cartoon and dissect it to reveal its elements and intentions.

The following are the components of the procedure:

1. TITLE: What is it? Does it mean something specific? Why was it chosen?

2. SYMBOLS: What do they mean? Are there clues to meaning in the title?

3. SITUATION: What is happening? Who is doing what to whom and why?

4. PURPOSE: Is this cartoon trying to explain? to poke fun? to arouse?

5. POINT OF VIEW: Does the cartoon show bias? Are there distortions which may be clues to how the cartoonist feels?

At first, use the TSSPP method with the class a few times before having students attempt to analyze cartoons independently. Use individual copies of the same cartoon or an overhead transparency to teach the method to the students. From this lesson they can progress to one or both of the next two activities.

ACTIVITY # 2

Have students analyze cartoons which they have brought to class from newspapers or magazines. These cartoons should illustrate some question or situation arising from the toxic substance problem. Teachers should be prepared to provide cartoons to those students who do not have access to newspapers and magazines. This should be done as a classroom assignment so that the teacher can provide help to students having difficulty. After students have used the TSSPP method to write an analysis, cartoons could be exchanged and analyzed. Students will benefit from the additional opportunity to develop critical thinking skills and, by comparing their analysis with another student, they will have opportunities to express their opinions and increase their reasoning skills.

ACTIVITY # 3

Students can be assigned to create their own cartoons which illustrate a situation, controversy, or problem arising from the toxic substance problem. (Cartoons are to be evaluated on the basis of understanding and not artistic ability.) These cartoons allow the student an opportunity to be creative while using critical thinking skills. They also provide an evaluation tool which can measure the student's understanding of events and cartoons as a means of expressing opinions.

Steps and Suggestions:

1. Make the assignment as specific as possible. Ask for a cartoon about a particular topic or give a list of topics to be chosen from:

    asbestos

    formaldehyde

    agent orange

    Love Canal

    mercury poisoning

    lead poisoning

    nuclear wastes

    hazardous wastes dumps

    kepone

    insecticides, in general

    uranium mining

    the Super Fund

2. Give students unlined paper and specify the size of the finished product. Announce a deadline.

3. Suggest that students begin to read the editorial cartoons and the comic strips with an eye to understanding why something is or is not "funny to me".

4. Use the cartoons included with this activity or bring in some from various periodicals. Discuss what is and is not funny; have students analyze each cartoon to identify technique employed -- i.e., exaggeration, oversimplification, caricature, stereotypes, play on words, satire, etc. It may be necessary to add more categories to this list as cartoons are collected and analyzed. Refer to the questions used with the TSSPP approach in Activity # 1.

5. With this background students usually are excited about expressing themselves by creating their own cartoons.

6. The teacher may consider compensating for any lack of artistic ability by allowing students to construct their cartoons from cut-outs of newspaper comic strips.

7. Grade these cartoons on creativity displayed and the degree to which your instructions were followed.

8. This exercise will be most meaningful when the first cartoons turned in are discussed and analyzed in class. After the discussion, repeat the assignment giving everyone a chance to improve his original cartoon and to begin with a fresh idea. The best cartoons and the most learning will usually be on the second or third cartoon.

9. Offer the best of your cartoons to the school or local newspaper for public display. Arrange a bulletin board of cartoons in a prominent area of your room or school. This will not only give recognition to the students but will also increase the awareness about hazardous wastes and toxic substances among the student body.

ACKNOWLEDGMENTS

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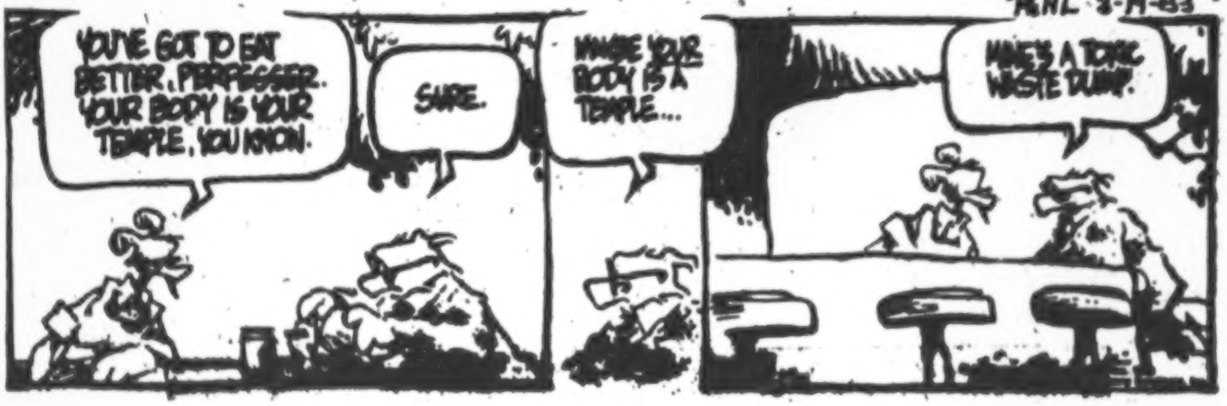
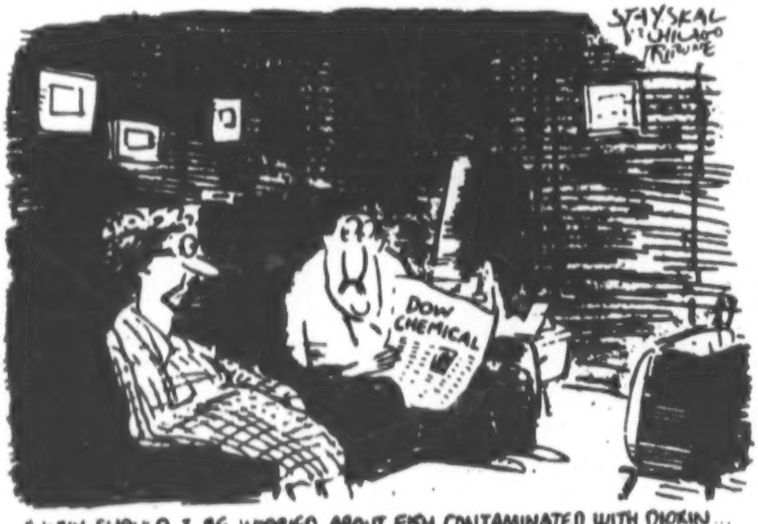
Shoe

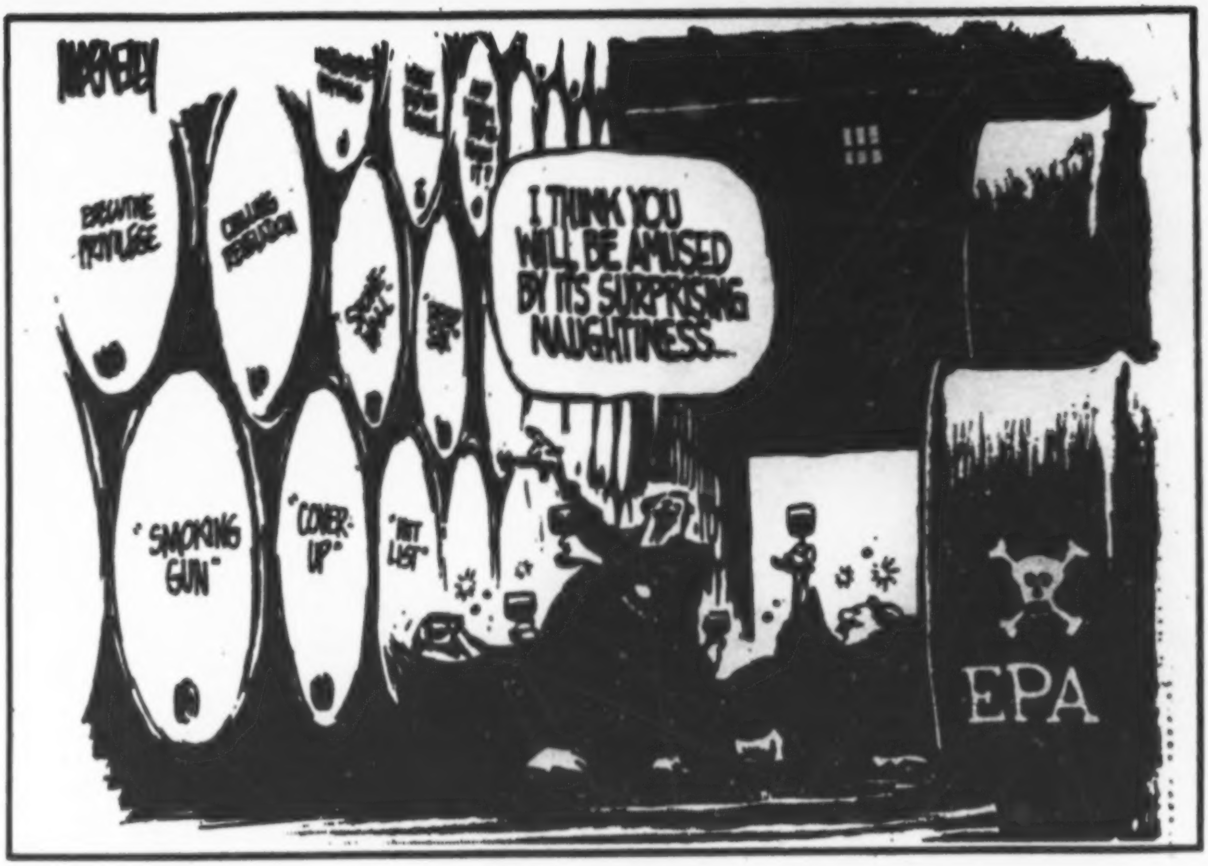
by Jeff MacNelly

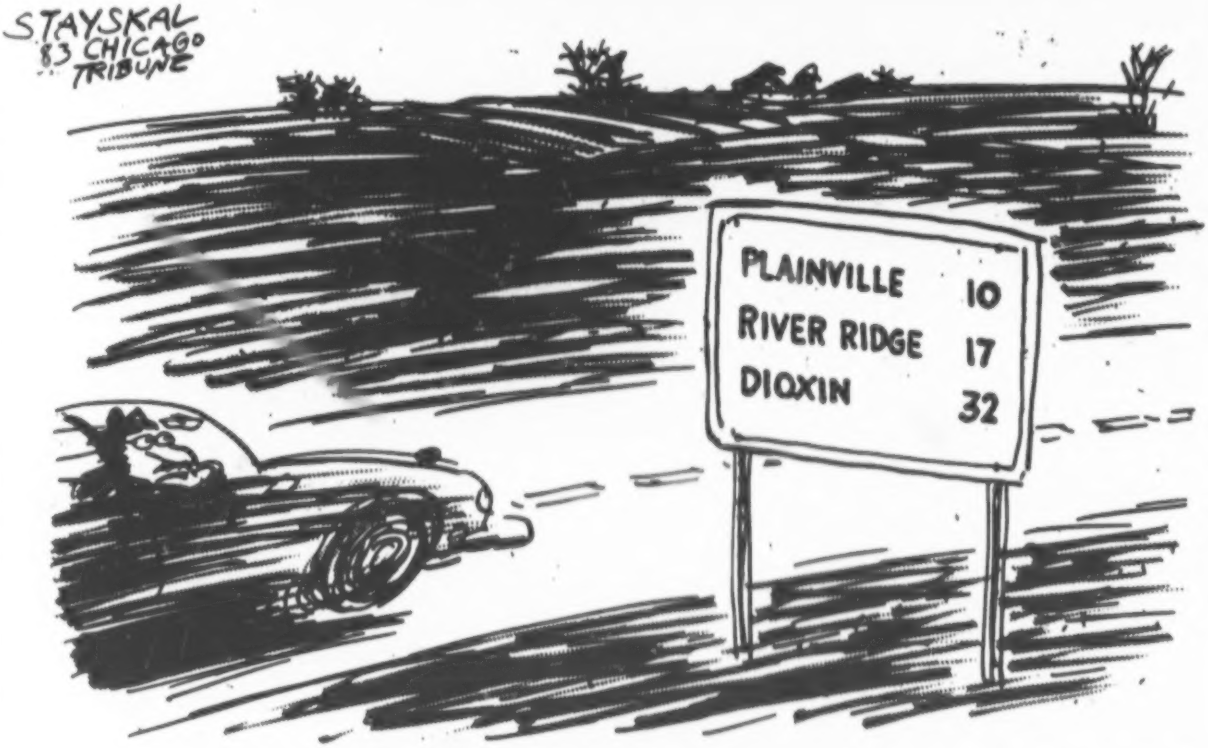
RNL 3-11-83

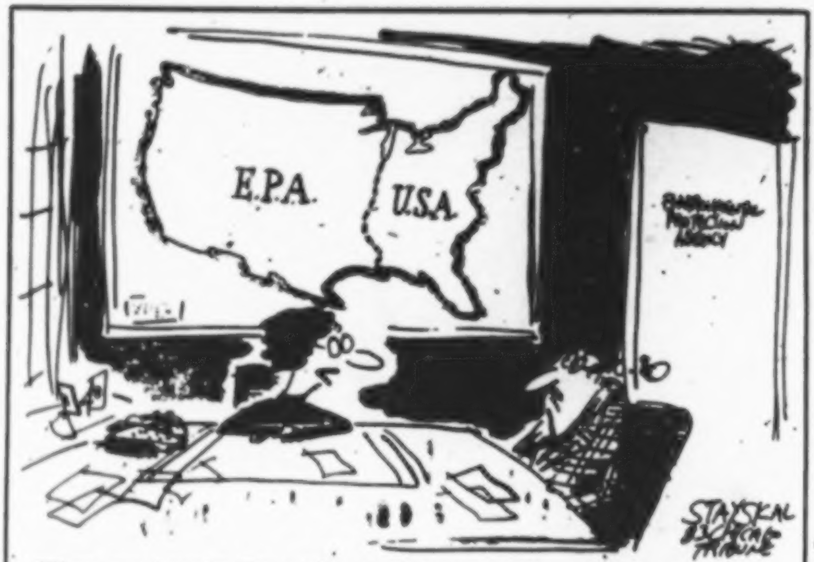

YOU'VE GOT TO EAT BETTER, PERFESSER. YOUR BODY IS YOUR TEMPLE, YOU KNOW.
SURE.
MAYBE YOUR BODY IS A TEMPLE...
MINE'S A TOXIC WASTE DUMP.


STAYSKAL
©CHICAGO TRIBUNE
DOW CHEMICAL

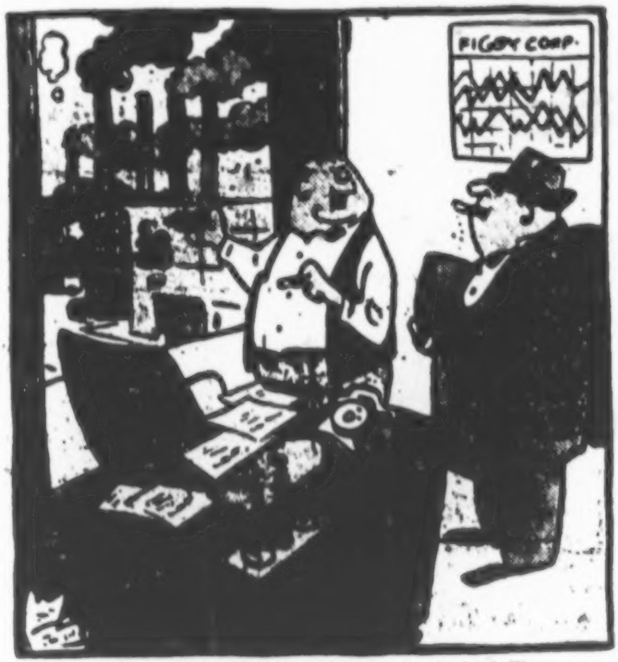
" WHY SHOULD I BE WORRIED ABOUT FISH CONTAMINATED WITH DIOXIN ... WON'T THE ACID RAIN KILL THEM ? "


MACNELLY
EXECUTIVE PRIVILEGE
CHILLING REVELATION
"SMOKING GUN"
"COVER-UP"
"HIT LIST"
I THINK YOU WILL BE AMUSED BY ITS SURPRISING NAUGHTINESS...
EPA

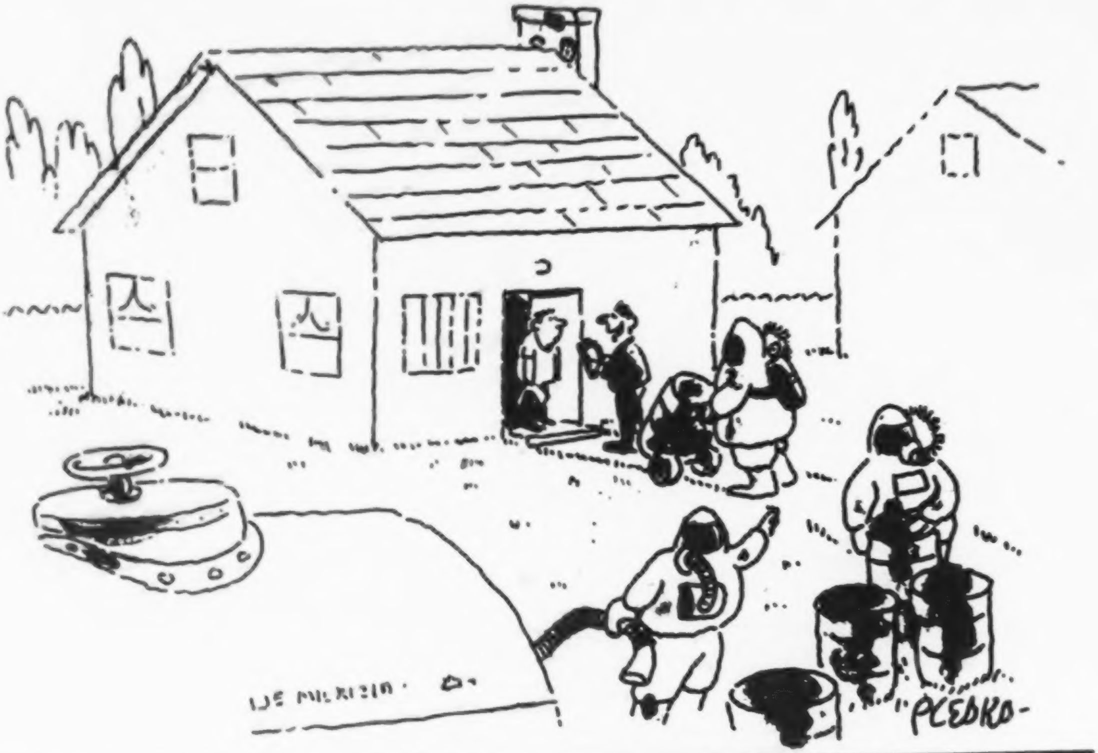

STAYSKAL
'83 CHICAGO TRIBUNE
PLAINVILLE 10
RIVER RIDGE 17
DIOXIN 32


E.P.A.
U.S.A.
ENVIRONMENTAL PROTECTION AGENCY
STAYSKAL

'First, we bought Times Beach, Missouri. Then a little place near Imperial, Missouri, had dioxin all over and we bought it. Then . . .'



"We're paid by the larger companies to look like we're creating more pollution than they are."



"Congratulations! Your house has just been selected as a hazardous waste site."

Propaganda: Its Nature and Uses

MAJOR PURPOSES

- *To develop insights about the nature and uses of propaganda
- *To become familiar with aspects of the toxic substances and hazardous wastes problem
- *To improve listening skills and the ability to transfer learning

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS/QUESTIONS

- *To be able to identify assumptions implicitly or explicitly present in different positions
- *To be able to analyze information for facts and opinions
- *To raise fundamental questions about man's nature that make certain techniques of propaganda work
- *To be able to identify attitudes of various parties involved
- *To help clarify values

INSTRUCTIONAL APPROACH

Because toxic substances is a contemporary topic and has proven to have high student-interest potential, it is used to introduce and clarify the often misunderstood and abstract nature of propaganda. Once the students' attention is gained and aspects of propaganda made salient using toxic substances, the resulting insights can be refined by using them to study almost any course in the social studies curriculum. In this project, however, examples of such application will be given for European and American history and for civics.

With this approach the odds are that students will have a more sophisticated knowledge of: 1. the toxic substances issue, 2. propaganda, 3. the topics or historical periods studied, and 4. such valuable skills as those noted above under the project's purposes.

OVERVIEW

The development of instantaneous communication technology has increased the quantity, but not necessary the quality, of information reaching students. The extent to which students are prepared to analyze and use this flood of information is an important concern for the social studies teacher.

One frequently overlooked aspect of analyzing information is the identification of examples of propaganda. Propaganda, according to the Random House Unabridged Dictionary, is "information, etc. deliberately spread widely to help or harm a person, group, movement, etc." Propaganda is not limited to any particular field of life, but for the most part it is thought of in connection with international politics and in a highly negative sense. But propaganda is neither always political nor negative. Most people would probably agree that a community service campaign to increase public support for more strict control of littering is a legitimate and highly positive example of propaganda. Students need to be aware of the positive aspects of propaganda and not simply the negative connotation the word usually implies.

Propaganda includes the use of value-laden words, opinion-molding illustrations, and omission of significant facts. Students are daily surrounded by propaganda techniques, but many are unaware of their existence. They should recognize this when making judgments about the information they are receiving. They must also be alert to the role of previously assimilated propaganda in their personal perceptions.

Toxic substances and hazardous wastes is an excellent topic for the study of propaganda. The subject is highly controversial and has produced many examples of propaganda -- emotional and intellectual, positive and negative. Accidents and disasters such as Love Canal in New York and dioxin in Missouri have been used by groups advocating increased toxic waste controls. Chemical industry and government agencies have responded with reports, studies, and films representing different or opposing viewpoints. There are probably such examples in each teacher's community or region with which students are familiar but have not thought of in terms of propaganda.

Using the toxic substances issue has the following advantages in stimulating students' interest. First, it is an unusual social studies topic. Second, the subject is one which touches most American communities, and therefore students can immediately perceive a value for their participation. Both of these characteristics have proven appealing to the student "turned off" by the unimportant or abstract topics.

THE LESSON AND ACTIVITIES

Beginning the Lesson

Considering the Definition of Propaganda:

To pique student interest and create an atmosphere of curiosity about the topic, the following historical case is used. It is based on a curious situation that occurred in a little settlement called Long Run in the Kentucky territory around 1804. The situation involved two groups with conflicting views about distorting the truth and provides a chance to consider the definition of propaganda noted earlier (i.e., information deliberately spread widely to help or harm a person, group, movement, etc.)

It seems that one group supported the father of four children who misled marauding Indians about the existence of the fourth child hidden under the house in hopes of saving him from the Indians. This group took the position that under the circumstances the father had the right, indeed the duty, to provide or withhold information that would help protect the child. The other group's belief was that the whole truth had to be told regardless of the consequences.

Now consider with the students such questions as follows:

> Could the father tell "the truth" and still protect the child? (That is, could he give information that was true while withholding or being vague about other information?)
> If so, would this be distortion? (The concept of distortion will likely need clarifying.)
> To what extent do the father's actions fit the definition of propaganda?
> Is distortion a form of propaganda, and is all propaganda distortion?
>
> (This is a rather unusual case with which to introduce the topic of propaganda. But this is its strength. It does get the students' attention, and they remember the case which serves as a good point of reference for subsequent discussions.
>
> It proved especially effective in establishing for students a more vivid concept of some of propaganda's characteristics than could be done with just the definition. For instance, the case and accompanying questions can make salient that propaganda might or might not be a lie or distortion and is not always harmful. Questions about what constitutes a lie or distortion is implicit in this example. These awarenesses, of course, should be refined as the activities in this project continue.)
>
> What sort of current issues illustrate the use of propaganda?
>
> (Bring up the environmental issue in general and more specifically toxic substances and hazardous wastes.)
>
> What are toxic substances and hazardous wastes?
> From where does our knowledge about these materials come?
> Is it important for us to be able to weigh the nature of the
>   propaganda being used? Why?
>
> (It is easy to show, using the toxic substances issue, why it is important to be able to identify different types of

propaganda. Such appreciation should add to the value of the following activities.)

Activity # 1:

Now distribute copies of the Doublespeak and Propaganda Techniques charts in the Appendix at the end of this particular project. Read to students a short paragraph from one or two items sponsored by special-interest groups, such as newspaper and magazine advertising, handouts, or public service announcements.

When this activity was tested in the classroom, several advertisements of the Mobil Oil Company were used. The editorial format of these particular ads focuses on the position of the company about such issues as private enterprise and the environment. The ads have run in a number of magazines and newspapers. Those dealing with environmental issues were then compared with some materials from the Sierra Club and the Chesapeake Bay Foundation.

Using the Doublespeak and Propaganda Techniques charts, analyze as a class the material to identify possible distortion or other propaganda techniques. (Prior to using this approach be sure to read and study the material to find clear examples for this initial activity of propaganda techniques.) This exercise helps prepare the students for Activity # 2 that follows.

Activity # 2:

Select two films from the resource section of this book -- one from an environmental protection viewpoint and one from a chemical manufacturer or similar source. Students should be shown the films without introduction other than to assign them the task of using the charts to identify specific examples of propaganda. After the films have students report their findings orally. Their examples will serve as content for further discussion. Topics which could be used include:

1. Specific examples cited by a student not perceived as propaganda by other students. Are we so skeptical of authority that we see manipulation or persuasion where it does not exist? Conversely, do we allow ourselves to be manipulated unwittingly?

2. The way our opinions are influenced by technique. Do we accept information more readily from certain sources? How does our individual "mind-set" affect our perceptions? Do we tend to hear what we want to hear?

3. The extent to which the conclusions and assumptions of the film makers coincide or conflict with ours. What are their conclusions and assumptions?

4. The extent to which the films attempt to answer or merely sidestep the implications of the toxic waste problem.

EXTENSIONS AND ALTERNATIVES

1. In place of films, invite a spokesman from a chemical manufacturing or toxic waste producer to appear before your class. Also invite a representative from an environmental or community group to present a different viewpoint. If the speaker is briefed in advance and alerted to the students' search for propaganda examples, the speaker may become too sensitized to his usage and not give sufficient examples for students to analyze. Also, propaganda, as mentioned earlier, has such negative connotations that a speaker might hesitate to participate, fearing an attack has already been made on his position.

Naturally, the teacher has the professional and academic responsibility to foster a spirit of objective inquiry. First, students should listen carefully and respectfully to what is being said and then consider how it is being presented. Usually, the differences between the speakers will be their basic assumptions rather than a deliberate attempt to distort. Yet, you can expect that each speaker will present his case in the best possible way.

CAVEATS

1. As stressed previously, it is essential that a spirit of objective inquiry be encouraged when using resources (speakers, films, readings, etc.) related to propaganda. This means weighing carefully and respectfully what is being presented and then drawing conclusions based on consciously applied and defensible criteria.

2. Related to the above admonishment is the recommendation that the teacher and students should be conscious of their own sympathies and predilections as the positions of others are analyzed.

3. Films should be previewed by the teacher to insure their suitability and to prepare questions for discussion before and after showings. The teacher may need to see several films before selecting two for viewing. Depending on length, films may need to be shown on separate days. Group analysis on each film should be done immediately following the film because memories fade and the discussion should be an accurate evaluation. Resources for research should be secured in advance and made available to the students.

4. Teachers may need to develop a vocabulary list of terms used in the analysis of propaganda and the terms used in the toxic waste controversy.

POSSIBLE COURSE APPLICATIONS

After the concept of propaganda has been made salient and less abstract using toxic substances, the understandings can used effectively in conjunction with such courses and topics as the following:

1. Civics: A political campaign is usually filled with examples of propaganda. Some candidates use propaganda techniques to sidestep critical questions or to cloud the issues. A campaign issue receiving ever-increasing importance is the toxic waste controversy. Propaganda is widely used by pressure groups to influence the public and legislatures in hopes of winning support. The role of pressure groups (lobbies) in our government and their use of propaganda techniques would be a beneficial study. Lobbies frequently claim to be "educating the public" with their propaganda. A question could be raised to decide whether education is a form of propaganda as well as if propaganda is ever educational.

2. American History: The movement westward was littered with propaganda. Horace Greeley's call to "go west young man", inducements to settle in certain areas and raise certain crops, and the information disseminated by transportation companies vying for business are some examples. The environmental movement traces its origins to the campaign for national forests and parks during the presidency of Theodore Roosevelt. Another Roosevelt used propaganda techniques to win support for his decision to intern Japanese-Americans in 1942. These and other uses of propaganda during war and peace can be used to refine understandings about it's nature, effectiveness, and legitimacy.

3. World History: Propaganda has been used by world leaders -- political and religious -- throughout history. The appeal made by Pope Urban calling for a Crusade is a good example of propaganda. Governments have used their powers of censorship to propagandize their citizens -- i.e. Nero in ancient Rome, the persecution of Jews in Nazi Germany. Of course, it was employed during the French Revolution, and Nazi Germany and Soviet Russia are case studies in its use in gaining and exercising power over their countries.

ACKNOWLEGMENTS

This revised and edited version was originally developed and evaluated by Janice Westbrook, Community High School, Richmond, Va.

PROJECT APPENDIX

Chart 1. Doublespeak

INTENSIFY OWN GOOD Emphasis on positive Building an image of friend	**INTENSIFY THE BAD OF OTHERS** Emphasis on negative Building an image of enemy
DOWNPLAY OWN BAD Present as servant of general welfare Aims presented as helping not hurting people	**DOWNPLAY THE GOOD OF OTHERS** Denial of claims of others Ridicule motives and intentions of others

Chart 2. Propaganda Techniques

ASSOCIATION: Guilt or innocence by associating a person, idea or object with something good or bad
BAND WAGON: Most people believe it, accept it, or are doing it
PLAIN FOLKS: Focus on common people, the average person, we the people
CARD STACKING: Twisting, distorting, suppressing, or inventing facts
GLITTERING GENERALITIES: Use of vague, ambiguous, virtuous, generally acceptable notions
NAME CALLING: Putting a bad label on individual, group, idea activity
TESTIMONIAL: Endorsement by prestigious individuals

ADDITIONAL NOTES

Getting The Lead Out: A Case Study

ACE
BATTERY

MAJOR PURPOSES

- *To introduce the uses and toxic aspects of lead
- *To illustrate how a toxic substance can possibly pollute an occupational environment
- *To show that environmental contamination by toxic metals is not necessarily a new problem
- *To provide some background information about odors

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS/QUESTIONS

- *To identify the specific effects of acute lead poisoning
- *To show the plight of a lead smelter employee as a case study
- *To identify the major sources of lead use and pollution in our environment
- *To illustrate that clean-up, control and decontamination technology lags behind the technology which uses and produces toxic substances
- *To indicate that to decontaminate and control occupational and other pollution involves questions of economics as well as safety
- *To show that there are positive and safe uses of lead
- *To realize that there is a time-lag between the recognition of an environmental insult and the positive action taken to correct the problem
- *To show the importance of proper protection and education for employees subjected to greater than average risks
- *To become familiar with various characteristics relating to the olfactory system
- *To recognize that air pollution is a multifaceted problem

INSTRUCTIONAL APPROACH

This lesson is suitable for Life Science, General Science, Physical Science and Biology students in middle school classes. It can be approached in a biology class as an example of a common pollutant both to the environment and man. Lead affects most of the organ systems of animals as well as causing problems in plants. It also can be included in a study of the olfactory system. In the physical sciences, the study of metals, mining, smelting, recycling, scientific application of technology and chemical characteristics of useful metals may provide an opportunity to include these materials. Certainly the students should be aware of examples and ramifications relating to occupational exposures, since they, in time, will enter the work force.

A general historical introduction of lead is presented to provide the teacher with background information, but we encourage the teacher to locate a copy via the school librarian, of the 1983 Environmental Protection Agency report on lead. This is a major study of the nation's lead contamination problem. Virginia teachers may want to have a student research and collect newspaper reports of the historical and current status of the lead smelter recycling plant in Richmond that is discussed as a case study herein. Other reports of lead contamination regularly are reported by the media and they often relate to the pollution of a specific geographic area. The problem of solder used in household and business water pipes is currently being debated. Even zoning boards and building inspectors are involved in deciding the allowable lead content of solder to be used in connecting the drinking water systems in new buildings.

Included as a class activity is a teacher demonstration of perfume diffusion. It is intended to illustrate odor as an early warning of potential pollution in the air, how the air contamination disperses itself, biological responses to the odor, how a pollutant can be carried out of the immediate work environment, and the conflict that often occurs between safety and profits.

Also included is a series of student tests of odors and smell that can be performed in the classroom using inexpensive perfume, cologne, or after-shave lotion. These solutions can be diluted easily, but students still should be asked to wear safety glasses. Some students may not like the odors, and they should not be forced to participate. Such materials may be included in the units where the nervous and sensory systems are being studied as well as in any unit dealing with environmental pollution.

Sample newspaper articles relating to lead are included for discussion. One article deals with solder use in the water pipes of homes, and the other relates to the pollution and occupational problems of a small recycler of lead from batteries. Each community will be approaching similar problems, and these examples can serve to illustrate this.

BACKGROUND INFORMATION

Lead is a heavy metal element, and other than mercury, it is the heaviest of the common metals. It is pliable, easily bent, and easily scratched. Lead can also be extruded into various shapes but has a poor tensile strength and poor ductility. It is almost completely resistant to corrosion by salt water and hard water; however, distilled water containing dissolved oxygen will cause some corrosion. Lead water pipes were used centuries ago and occasionally we still read about a modern city uncovering an old lead pipe in their water system.

Lead and lead compounds are poisonous if ingested or inhaled. Some forms of lead may even enter the body through unbroken skin.

The United States is the world's largest producer of lead in its natural form, galena (a lead sulfide). Lead ore is subjected to a series of processes which removes specific impurities, and it is then sent to a variety of industries.

Lead monoxide (litharge) is the raw material for most other lead compounds. It is used to manufacture lead storage batteries, glass, ceramics and in the refining of oil. Red lead (minium) and white lead (lead carbonate) are both pigments. Organic compounds of lead are used as ingredients in paint driers, lubricating greases, and as oil additives. Tetraethyl lead is added to gasoline to prevent engine knock. Smaller quantities of lead have been used in plumbing, as cable covering, as a protective lining of storage vessels, in printing, and as a protective material in walls and clothing used in radiation work. Alloys of lead are used in a corrosion-resistant coating for containers and as a roofing material. Due to the low melting point of lead, it is also used as an ingredient in solder and in some fire alarm systems.

The majority of refined lead is used in storage batteries; this lead can be recovered and recycled. The second major industrial use of lead is as a gasoline additive; this form is not recovered. Tetraethyl lead can enter a human body through unbroken skin. It remains in body tissue as a soluble salt. Tetraethyl lead is also a major contributor to the lead particles in air pollution.

Lead is present in our food, our air, and our water. A contemporary American cannot avoid some level of contamination. Lead solder is used to seal some of our canned foods. In America the Poisoned (1982), Regenstein writes that an uncontaminated control group would be impossible to locate. Over exposure to lead surely affected the progress of the Greek, as well as the Roman civilizations. We know that the Romans used lead water pipes, and that they lined their cooking, eating, and wine-storage vessels with lead.

Our civilization is exposed to lead in the form of air pollution from lead smelting and from the combustion of leaded gasoline; however, exposure through food and beverages is still higher (except in Los Angeles and a few other highly congested areas). We accidently ingest lead in the form of pesticides remaining on unwashed vegetables, paints, solder used to seal food containers, lead pipes, and lead particles chipping off of certain ceramics, glassware, and cookware.

The average American, in 1965, ingested 400 millionths of a gram per day. The average American, in 1968 had 0.25 ppm in his blood. Garage mechanics and parking lot attendants had 0.34 ppm. According to the 1983 EPA report on lead, Americans ingested 100 mg of lead per day, giving about 1.25 ounces annually.

Research completed on the Greenland ice cap indicates that from 1750 to 1940 lead in the ice increased five fold and from 1750 to 1967 lead in the ice increased twenty fold. This research used the amount of sea salt in the ice as a control. The sea salts did not increase. Throughout the northern hemisphere of the earth, this exponential increase of lead contaminations exists. The same is not true in the southern hemisphere, where fewer gasoline engines are found. Air movement patterns probably prevent transfer of lead particles from north to south also. An estimated 430,000 tons of industrial lead finds its way to the oceans yearly. This was estimated in 1972. We know that lead accumulates in the livers of most fish.

Lead is a cumulative cellular poison. Less is known about the chronic effects than is known of the acute symptoms. In addition, there is a strong possibility of synergistic interaction with other environmental pollutants.

Lead poisoning is a chronic disease caused by the assimilation of large amounts of lead or lead compounds by the body. Lead may enter the body by inhalation, by swallowing or by absorption through the skin. Lead enters the bloodstream and circulates as a soluble salt. Some of this material is absorbed by the kidneys and the liver, but most of the lead is eventually stored in bones. This has effects on calcium metabolism and on the formation of blood cells. The first noticeable changes in calcium metabolism cause diseased teeth, and a blue line (lead sulfide) on the gums.

Other symptoms include: severe anemia, pallor, weakness, loss of appetite, apathy, insomnia, constipation, premature aging, nervous irritability, erratic behavior, reduced learning ability, awkwardness, insanity, decrease in sperm production, malformations in sperm, sterility, miscarriage, stillbirths, premature labor followed by the death of the child, blindness, and lesions of the neuromuscular system, circulatory system, brain, and gastrointestinal tract. Lead is an enzyme inhibitor, inhibiting cell metabolism in specific organs. In adults, it is stored in bones, however in children, it distributes all over the body leading to mental afflictions, brain damage, or death. The effects on the brain have been observed in cases of very low levels of lead. Babies and children have gotten lead poisoning from chewing the paint on their cribs, eating paint off window sills, or eating peeled paint from the walls of old homes. Since much of the housing stock of America's inner cities was built in late Victorian times, when the use of lead in paint and piping was at its height, almost any renovation will release huge amounts of gray lead dust into the air.

Even though lead is one of the most widely recognized environmental poisons, removing it from our environment is a highly complex and expensive task. We have come to rely on this metal for its many positive qualities. Also, it is already spread far and wide. In Human Ecology, the Ehrlichs state, "As we strive to reduce the percentage of contaminants per unit volume of effluent (air or water) to very low levels, the cost of the control measures in money and energy become very large. In fact, reducing the contaminant concentration to zero would require an infinite amount of energy. Long before we got there, of course, the environmental impact associated with supplying the energy for pollution control would exceed the impact of the pollution we were trying to clean up". Certainly levels should be reduced to a safe concentration even if the clean up is expensive.

A HANDOUT FOR DISCUSSION OF AN AIR POLLUTION CASE STUDY

This case that begins on the next page is based on newspaper articles and can be used as a handout to the students. It would be an example of air pollution, including smoke and odor pollution, occupational hazards, economic impact, and the resulting legal complications. After the students have read this summary included below or any of the original newspaper articles related to the topic, a teacher-led discussion may include consideration of the following ideas: the dilemma of short-term gain against long-term consequences; economics versus health; and the outcome of the alleged criminal case.

The Case of a Lead Smelting/Recycling Operation in Richmond, Virginia
(A Summary of Several Points of View)

Consider the situation of a lead smelting firm located in a partially residential neighborhood. Since being established in 1941, this has been a family owned and operated business. Employees work eight-hour shifts and there are three shifts, keeping the plant running 24 hours a day when times are good economically. The business is a type of recycling, where the lead smelters collect, melt down, and remove impurities from crap lead. The purified lead is then sold to other industries to be reformed into a new product. From the point of view of the family, this has been a highly successful business. The recycling of lead has saved the industry the time and money necessary to mine even more galena. As the country has become increasingly aware of ecological concerns, the federal and state governments have sent this smelting firm more and more paperwork having to do with methods of operation. More time has been spent reading the bulletins, filling out the reporting forms, and escorting the inspectors around the plant. Eventually, pollution control became so complicated that the bulk of the paperwork had to be turned over to company lawyers. The governments set policies and deadlines with which the small family firm could not comply. More paperwork was necessary to request variances from the policies and extensions on the deadlines. All of this paperwork was necessary by law, but none of it added to the company's profits. In fact profits went down as huge sums of money had to be spent on pollution control equipment and in-house monitoring of problems.

Now the point of view of the neighboring homeowners must be considered. Back in the forties, when the industry was young, the smoke and odors that the plant emitted were not pleasant, but the husbands and sons of the neighborhood were working a full week. The odors were the smells of prosperity to the neighborhood. If people had some trouble breathing, if the house paint was discolored, if the shrubbery would not grow, if the weekly wash hanging on the line became dingy while hanging there, what was that compared to a good paying job with a prosperous local industry? By the 1950's, the honeymoon had ended, and some of the neighbors had jobs elsewhere and complaints began to come into the front office. At one point, a group of residents threatened court action, but about that time the small brick chimney was replaced by a 150 feet tall steel smokestack. The firm was trying to clean up the air. The air in the neighborhood was cleaner for awhile. At least the smoke and fumes were released higher above the plant and the particles dropped over a wider area.

As the firm continued into the 1960's, residents in the area were becoming sparse, some having moved, and very few new residents became replacements. Also in the 60's, Americans began to become interested in "ecology" and environmental issues. Saving the environment became quite popular. The remaining residents around the lead smelting firm did not think too much about ecology, but the federal and state governments were beginning to inspect and restrict emissions into the air. The air in the neighborhood was apparently of poor quality, but it probably was not as bad as it used to be.

The group of people caught squarely in the middle between concern for health and concern for profit were the employees of the firm. The jobs available in a lead smelting plant were jobs for men: heavy labor, long hours, but good pay. Since this was a small family business, there were not so many "benefits" - no retirement pension, for example; however, there was a company doctor on the premises and after all, the pay was good. As the government slowly but surely forced the company to control the levels of lead emissions from the plant, the employees continued to perform their tasks inside the plant where the air was thick with fumes, and particles and the floors were sometimes puddled with acids from the batteries being recycled. Some of the employees never had any sickness associated with the workplace, but the majority of them fell into a pattern of work, sickness, and then back to work. Their symptoms ranged from dizziness, nausea and vomiting, loss of weight and anemia to total exhaustion. These are all symptoms of lead poisoning. The first company doctor, upon examining the sick men, would fill out forms for workmen's compensation stating that the symptoms were being produced by the workplace. The boss then intervened. He asked the doctor to treat the employees, but not to tell them what was wrong, therefore denying them workmen's compensation. The first doctor refused and was replaced. The number of workmen's compensation claims went down. The company hired a private laboratory to come to the plant on a monthly basis and do air monitoring, metal sampling, and blood testing of all employees. Tests from this laboratory consistently indicated that the level of lead in the blood of employees was within safe ranges. Symptoms continued. As state and federal standards for the "safe range" became more stringent, the lead levels in most employees' blood tests went uniformly down. Those employees with symptoms that were severe enough to require hospitalization had additional blood tests completed by the hospital. The blood test data from two local hospitals showed dangerously high levels of lead and severe lead poisoning, even though the company tests did not. In addition to being sick, the employees were often confused by conflicting test results and advice. Some had been with the company for 20 years or more. As they became older and more sickly, they lost their ability to work. With no pension to look forward to, earnings were important to maintain. They were beginning to lose faith in the small family business which had employed them.

A recent irony in this story concerns the employee who had been fired because he refused to submit to monthly blood tests. He apparently returned the next day with a gun and shot three men who were in supervisory positions over him, fatally injuring one of them. His defense attorney based the case on the high level of lead found in the man's blood as a cause of his behavior.

A CLASSROOM ACTIVITY RELATING TO ODOR POLLUTION

Since odor pollution was a part of the previously presented lead smelter pollution case, several odor-related activities can be undertaken. Consider introducing the students to the classification of odors. This commonly constitutes a blend of four primary smells: fragrant, acid, rancid and burnt. If the primary smells could be measured on an arbitrary scale, every odor on earth would be given a distinctive number based on the strength of its constituents. Have an example in a sealed and labeled container for fragrant and burnt odors. Use a hood if you have one available. Do not use or allow students to smell the acid or even the rancid types because of potential damage to the respiratory system.

The classroom can be used to illustrate the dilemma of the employee who is making money on the job, while also being subjected to industrial pollutants in much greater concentrations than those found outside the workplace.

Group Activity:

Provide the students with a handout containing selections from the questions below or questions relating to lead. Previously saturate the paper with some perfume; several drops should be sufficient in the upper right hand corner. For use of this "unknowningly contaminated paper," refer to the section below title, "Next Class Meeting."

For another activity, consider the following set of experiments. Provide the students at each table with a set of 10 test tubes containing various dilutions of perfume in water. These should vary from levels that are non-detectable to some samples containing the pure material. Be sure to include a sample of pure water, your dilution material, as a control. It may be necessary to substantially dilute these mixtures. It is recommended that they be in the screw cap type of test tube. Instruct students to test for odors by holding an uncapped test tube 18 inches from the nose and using a slow waving motion with the hand to circulate the odors toward the nostrils. Since these tubes are numbered, each student should record the number on the tube which they can or cannot detect the odor. Essentially they have determined their own olfactory threshold for this perfume or cologne.

A variation of the above experiment would be to determine which cologne is the one of preference. In this case simply have a series of unlabeled test tubes containing various perfumes or after-shave lotions. Each student would be asked to rank the samples from most pleasing to least pleasing. You might ask them what their basis for selection was.

Continue to remind the students to recap their test tubes, so they can be used by other classes during the day.

Class Activity:

Explain to the students that the classroom represents the factory, and they are to be the employees. They are engaged in work which they enjoy and are earning an above average salary. Allow them to suggest what this hourly rate might be.

The salary is earned only when they work.

At this time send two students on an errand or a library research project for 10 minutes. With the door and any windows closed, the teacher should circulate around the room spraying an atomizer of inexpensive perfume into the air above the students. Initially the odor should be slight and not too offensive ---- perhaps, even pleasant to some, since it represents the profits all are producing. As the teacher continues to walk around the room spraying the scent, use the following questions to elicit discussion:

1. In a factory, what do the odors of raw materials or products represent to the employees?
2. We identify odors as pleasant or unpleasant. Can we also base our opinions on what is good for you or bad for you? How can one determine if an odor is hazardous to you?
3. What other factor needs to be considered about the odor? (concentration)
4. Is the odor scenting the air around me diffusing from a source? How does diffusion work? Is it temperature related?
5. Can this perfume hurt my clothes? My hair? Would it be dangerous if I swallowed it with my food?

If we continue long enough, the olfactory receptors in our nose will become over worked, and we will become used to the smell or stop noticing it. This is often known as olfactory acclimation. About this time the two students sent on an errand should return and be questioned about their impression of the odor level of the perfume in the room. The teacher should also review for them the happenings while they were out of the class.

The recover time for olfactory detection of the odor can be measured by sending pairs of students outside and returning at specific time intervals ranging from 1 to 10 minutes. During this testing the teacher may find it necessary to continue spraying the perfume. Since individuals differ, possibly larger groups may be needed for better results. The teacher may want to keep a running record of the data from class to class and year to year.

Additional Questions:

1. Are all obnoxious odors unsafe?
2. What is OSHA and how does it function?
3. Define diffusion.
4. How are odors produced?
5. What eventually happens to odors?
6. List several occupations where odors are encountered.
7. Comment on the lead level in the blood of Toll Road Collectors.
8. Does a lead pencil contain lead? (graphite)
9. How do we smell?
10. Do all animals have olfactory organs?

Next Class Meeting:

After reviewing or checking on the questions asked on the handout sheet secretly contaminated above in the "Group Activity" section, break the news that their paper had some perfume placed on it purposely by you. Confirm this by asking them to check for the odor on a specific place on the paper. This represents a spill in the factory and the paper represents their clothes or any other item they took home from work. You ask them to trace the spread of the odor or contamination by listing where it was used and stored. Such as using the kitchen table, desk, bed ..... as the site to complete the questions.

Requiring this as a parent-signed homework assignment should help assure that it has some travel exposure. The teacher should continue to impress upon the students how simple it is to spread contamination.

Sample Newspaper Articles Dealing With Lead For Classroom Discussion:

Below are two articles from the Richmond News Leader that were printed in 1983 and are representative of common incidents often reported by the media. Such articles should provide additional examples of the lead problem as well as providing additional material for class discussion. In the space immediately below, you may want to list additional articles that are relevant to this topic.

Solder labeled health threat

By Hugh Robertson
News Leader staff writer

In an investigation with statewide and possibly national implications, an engineering consultant hired by Chesterfield County has concluded that the use of lead-based solder to seal plumbing joints can pose a health threat to owners of new homes.

The investigation was undertaken following complaints this summer by a Brandermill couple, Douglas and Jeanette Corkum, that the water in their new, $158,000 home at 4016 McTyree's Cove Terrace was bad and they had suffered from vomiting, diarrhea and fatigue since moving into the home in January.

Because of the consultant's findings, the solder problem will be laid before the state Board of Housing and Community Development next month with the suggestion that the use of lead-based solder be prohibited in future construction.

The state board administers the Uniform Statewide Building Code to which home and other construction in Virginia must conform.

Additionally, the Virginia Department of Health plans to undertake a statewide study to determine how much of a health danger, if any, may exist in new homes where the lead-based solder was used.

In the meantime, according to Assistant Health Commissioner Robert B. Stroube, owners of homes less than 2 years old who feel they may have a water safety problem should run their water through faucets "a couple of minutes" before drinking it.

Problems with lead and copper in new home plumbing systems usually are resolved, with the metals flushed out, in about two years, he added.

However, Dr. Stroube cautioned that just how much of a problem exists from use of lead-based solder is unknown at present.

Dr. Stroube also reported that water quality problems may be created by using water with a high acid content, such as is sometimes found in wells. Corrosion may occur, putting copper into the water system, in these cases, he said.

In Chesterfield, County Administrator Richard L. Hedrick also cautioned that "our data right now is rather uncertain" and how much of a problem exists is unknown.

Laboratory testing of the Corkums' water by the state health department disclosed it was highly contaminated by both lead and copper. In one sample, the metal content was 200 times that allowed under federal and state health standards. The tests also showed the county-supplied water was not at fault.

The Corkums' problem then became involved in suits and countersuits filed by the Corkums and their contractor, Edward J. Buzzell Jr.

On Oct. 27, the county hired the Jordan firm to investigate the situation and recommend what could be

☐ See Solder, Page 4

Solder

☐ Continued from Page 1

done about it.

Last month, the plumbing beneath the Corkums' home was removed and the soldered joints opened and examined.

Additional tests were made by the health department of water which had been allowed to stand for several hours in the joints. Again, high lead and copper content was found.

In a Nov. 10 preliminary report to the county's top building official, Robert S. Hodder, the Jordan firm said, "Several relatively new homes in Chesterfield . . . have been found to have high lead levels in the internal water piping system which are far in excess of the . . . limit." The limit for lead is .05 milligrams per liter.

"Some have levels in the 5 to 6.1 milligrams per liter range," the report said.

"All of the homes involved were relatively new and built by different builders and plumbers" and were in different parts of the county, the Jordan report continued.

The firm also reported that all the houses concerned had copper tubing in which the joints had been sealed by what is called "50-50" solder, which is half tin and half lead. The 50-50 solder is commonly used in home construction, according to building officials.

Additionally, the Jordan firm reported that a "self-cleaning" plumber's flux had been used in each instance. The flux is a liquid which is used in conjunction with solder in sealing pipe joints.

The problem apparently is a far-ranging one, the report continued, because difficulties with water systems where lead solder has been used have been found in Long Island, N.Y.; Carroll County, Md.; Seattle; Portland, Ore.; England; Canada; Scotland and the Netherlands.

"There definitely is a problem associated with the use of 50-50 solder in copper pipe joints which results in lead levels in the water system higher than the federally mandated levels," the report said. "The overwhelming consensus has been in previous problem areas to preclude the further use of lead solder in copper piping."

The report urged that lead-based solder be banned and that solder without lead be required in the future. It also said use of the "self-cleaning" flux should be investigated further.

As did the health department, the

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report recommended that owners of new homes let their water run for several minutes before drinking it.

"It does appear, however, that the problem dissipates within about (two years). . ., after all the lead in contact with the water has been corroded and flushed through the water system," the report also noted.

Neal Barber, deputy director of the state's housing and community department, said the agency's staff would lay the problem before the state board at its Jan. 9 meeting and suggest that a solution would be to prohibit use of the 50-50 solder.

Instead, the code should be revised to require use of "95-5" solder, which is 95 percent tin and 5 percent antimony, Barber said. The antimony contains just .02 percent lead, according to the building code.

Barber said the department has learned the use of lead solder recently has been banned in California and New Jersey.

However, the Virginia building code allows the use of 50-50 solder, and, until it is changed, local building officials have no authority to prohibit use of that type solder.

Barber said that, if the board decides to require use of 95-5 solder, the code-amending process would take about seven months. Various procedures, including the calling of public hearings on the proposal, would have to be followed, Barber said.

In a followup Dec. 5 report to Hodder, the Jordan firm reiterated, "It is apparent that the lead-tin solder was the source of the contamination in the Corkums' piping system."

Once new piping, using 95-5 solder and a different flux, was installed in the home, the problem disappeared, the report said.

"We feel that the recommendations made in our preliminary report are still valid," the followup continued, adding that the state building code should be changed.

"Consideration should be given to testing the water supplies in recently constructed public buildings," where children are present, such as schools, day-care centers and nurseries, where lead solder and copper piping have been, the report also recommended.

"We hope that our reports will help to solve what has apparently been a longstanding problem which no one was aware of until recently," the report concluded.

Lead dangers cited at battery company

By Dawn Chase
News Leader staff writer

Employees of a small Chesterfield County battery recycling firm have been exposed to dangerous levels of lead and unsafe working conditions, according to a 25-page list of citations issued by state health inspectors.

The C & R Battery Co. Inc., which lists a business address of 7516 Jefferson Davis Highway, in some cases was aware of the potential health dangers around its recycling shop at 1320 Bellwood Ave., said Dr. Clarence H. Wheeling Jr., director of enforcement in the Virginia Department of Health's Bureau of Occupational Health.

Fines of almost $25,000 have been levied against the business by Dr. Wheeling's bureau and by the occupational safety and health division of the Virginia Department of Labor and Industry.

Efforts to contact the firm's owner, Charles L. Guyton, and the firm's lawyer, Clarence B. Neblett Jr., were unsuccessful this morning.

C & R Battery Co. employs about 10 people at any one time, but "none of them stay very long," Dr. Wheeling said. The firm extracts lead from old batteries for recycling.

The two health inspection divisions started investigating the business after receiving a complaint from a physician who had treated an employee of the firm, Dr. Wheeling said.

The type of lead found around the battery firm can be absorbed by the body through breathing and ingestion, Dr. Wheeling said. It can cause damage to the kidneys, brain and other parts of the body.

According to the citations, issued last Wednesday, the inspectors found that, on some occasions:

- Employees were exposed to lead concentrations in the air that in some cases were more than double what the government considers to be safe lead levels.
- Employees who were exposed to the excessive levels were not issued protective clothing, or respirators, as Virginia law requires. The law also says that employees should not smoke, eat or use cosmetics in areas with excessive lead levels, but the firm did not enforce those laws.
- The firm did not follow legal guidelines for monitoring lead levels in employees' blood. The firm did not routinely measure exposed employees, nor did it notify employees whose tests showed excessive levels of lead.
- Instead of providing fountains and taps from which clean water could be obtained for washing and drinking, the company provided water in bottles that employees shared. Not only does this pose a way for communicable diseases to be transmitted, but the water was contaminated with lead, the inspectors reported.
- The building had structural problems that made it unsafe, and it was not kept clean.

The firm was ordered to correct most of the problems before the end of the year.

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VOCABULARY

Lead, risk versus benefits, galena, litharge, minium, lead carbonate, tetraethyl lead, neurological damage, anemia, convulsions, smelting, solder, OSHA, concentration, olfactory bulb, smelling salts, lead pencils, lead paint, lead in automobile body repairs, smell, odor classification groups, pheromone, receptor cells, conchae, hound dog, nostrils, septum, olfactory nerves, rhinitis, olfactory threshold, olfactory acclimation.

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ACKNOWLEDGMENT

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River Pollution: Developing Geographic Understandings

MAJOR PURPOSES

- *To consider sources of river pollution
- *To develop geographic understandings of the region including river, town, city, and industry locations
- *To develop map-study or possibly map-making skills

RELATED CONCEPTS/UNDERSTANDINGS/QUESTIONS/SKILLS

- *To develop an appreciation of a resource that is often taken for granted
- *To recognize that steps can be taken to reduce river pollution
- *To relate regional geography to selected historical events

INSTRUCTIONAL APPROACH

The problem of pollution is used to initiate a study of Virginia's rivers and significant population and industrial locations. Students will engage in map-study and possibly map-making activities. The time required could be from one day to several depending on which variations of the activities are used.

OVERVIEW

Many students are unaware of the importance of rivers, historically or currently. The approach used in this project serves as a very good point of departure not only for map study but also for other geographic investigations, such as regional characteristics of the state. In addition, the historic role of rivers and the development of communities and industry along the waterways can be considered.

In the description that follows, the James River is used to illustrate the activities of this project. Teachers in localities near other major rivers may find it beneficial to use the waterways in that particular region as the initial study. Once this is done, students could work in small groups to study other major rivers in the state (or even the nation, if appropriate) employing the approach used in the initial effort.

ACTIVITY I

The first activity sensitizes students to the source and condition of their drinking water -- another resource that is usually taken for granted. This provides a concrete starting point for a study of areas or topics which otherwise might be too removed or abstract to sustain student interest.

Several weeks prior to the start of this activity, either the teacher or students should write the Chambers of Commerce or county agents of the cities or counties west of Richmond (or your locality), asking for information on the industries in their area that are located near the river or its immediate tributaries. Other materials needed are the following:

Pitcher of water from a nearby river or stream -- polluted.

Pitcher of water from the regular source of drinking water.

Clear plastic drinking cups.

Large map of Virginia with the river clearly marked.

Map of Richmond or your city with the river clearly marked.

INTRODUCTORY PROCEDURE:

Begin class by asking students if they would like a drink of water. To those who respond positively, offer a glass of water from the pitcher which contains water you have taken directly from the nearest body of water (river, lake, etc.). The response should be negative. Then offer them a glass of water from the pitcher of water you have drawn from the faucet. At this point explain that the water in both pitchers came from the same source, the James River, in this case.

Now compare the two water samples. Ask the class such questions as: What is the difference between the two water samples? Why does drinking water have to be treated? Why is it not safe to drink water directly from the river or lake? Students will respond eventually (and you can lead them to this response if necessary) that it is because of substances dumped into the river. This sets the stage for a more careful study of types and possible sources of pollution found in the water supply.

ACTIVITY II

Ask the students to use the materials from the county agents, Chambers of Commerce, etc. to trace the source of their drinking water upriver and locate the possible sources of pollution. Provide a large map (wall-size if possible) of the river and also notebook sized maps for each student. As they trace the river on their maps, consider why cities and industries locate in certain areas, how the water flows through mountainous regions, the topography of the land through which the river flows, etc.

Have the class consider how specific industries located on or near the river or its tributaries could affect the quality of the water. At this point, the class could reflect on the fact that hazardous quantities of wastes are a reality that must be addressed unless we want to give up the benefits and conveniences of a technological society. This should be put into concrete terms by having students consider some of the conveniences that result from the products of industry and the value they place upon them.

It is important for students to be aware that industries are not the only contaminators of the water. They should recognize that hazardous wastes can come from disposing of household wastes, such as everyday chemicals, cleaners, sprays, insect and weed killers, and raw sewage. Also, especially in the past, rivers and their tributaries were the direct disposal dump (not a controlled site) for such discards as unregulated industrial wastes, junk cars, old radiators, tires. The list is endless. In addition, rivers receive in varying amounts what is called "non-point pollutants". That is, runoffs from fields that have been treated or exposed to pesticides, herbicides, etc.

Rain, which replenishes the streams and rivers, is also a contaminant, as it often contains toxic substances put into the atmosphere by individuals and as a by-product of the manufacturing and mining processes. Acid rain is increasingly in the news, and its possible source and effects are being debated. Refer to the Audio-Visual Appendix for a brief description of two presentations: "Acid Rain - The Choice is Ours" and "The Water Crisis". A number of other audio-visual presentations described in the appendix include material related to water pollution.

ACTIVITY III

From the preceding activities, the investigation can be extended to other waterways of the state or country. The class can be divided into groups with each focusing upon a major body of water and the region it drains. Each student in each group could be responsible for a particular topic that relates to the region, such as those mentioned under Activity II. The immediate purpose of this activity is to develop a map of the specific area under study by the group using the contributions of each student.

Several possibilities can grow out of this group work. One is to have each group present its findings to the class using the map developed and explain the interesting and significant findings about the region served by the body of water. The rest of the class would be expected to add this information to their personal maps and be responsible for knowing this information and why it is important. A second possibility is have the entire class make a large composite map from the different group maps.

With either of the above, students could make the features salient by cutting out and numbering pictures of the industrial plants, geographic features, historic sites, etc. and using these to make a bulletin board. The numbers would correspond with those that would be put on the map or model at the appropriate places. Of course, the pictures could also be attached to the map.

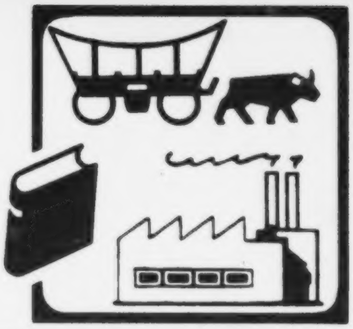
OTHER EXTENSIONS AND SUMMARY

In summary, this project at the outset employed concrete examples with high-interest potential for students (the source and condition of their drinking water) as the basis for making certain geographic understandings less abstract and more pertinent to the students' vested interest. This concrete-to-abstract approach could be extended to history classes by having individuals or groups identify, locate, and explain certain historic events that took place in the areas under study. The class might consider if and how the geography of the area influenced the way certain historic happenings occurred or developed. They in turn, could draw upon their earlier activities in this project to recall how some the developments have affected the waterways, specifically, and the environment in general.

ACKNOWLEDGMENTS

This revised and edited version was originally developed and evaluated by Hilda S. Morano, faculty member of Tuckahoe Middle School, Richmond, Va.

Toxic Materials Instruction In U.S. History Courses



MAJOR PURPOSES

*To heighten awareness of man's known and unknown encounters with possible toxic substances and hazardous wastes throughout American history
*To consider how and why people in different periods of history viewed and addressed their waste problems and the degree to which these views and actions have changed

RELATED CONCEPTS/UNDERSTANDINGS/QUESTIONS/SKILLS

*To make salient man's encounters with toxic substances and hazardous wastes as part of an environmental or ecological thread in the study of history
*To show that the problem is not a new one
*To reflect on the possible consequences of man's lack of awareness of the course of history and its implications for the future

INSTRUCTIONAL APPROACH

The approach is to provide students with opportunities to consider the problem of toxic substances and hazardous wastes as a thread in American history. The suggestions in this project are to indicate where and with which topics some of those opportunities might be pursued.

OVERVIEW

History courses provide an excellent opportunity to have students consider the continuity and change in man's attitudes and actions during different periods. Such considerations also enable selected topics to be developed into threads which shed light on the important issues and characteristics of today's society. Certainly, the environmental implications of toxic substances and hazardous wastes constitute an issue whose evolution can and should be traced, given its critical importance to all citizens.

Just as significantly, by using this approach, many often overlooked realities faced, knowingly or unknowinglyly, by people in different periods are made more salient. This contributes to developing greater empathy and thus creating more appreciation of the period and what can be learned from it.

As this project shows there are a number of places in the American History course where this topic can be incorporated while other topics are considered. With this approach a rather sophisticated awareness or appreciation of the topic can be gradually structured. Each time the issue is introduced less time has to be spent on the previous understandings making more time for new insights to be introduced.

Toxic substances and hazardous wastes can develop as a thread by itself or as part of a environmental or ecological thread. Since one of the considerations is the way people thought or didn't think about the matter, it also would contribute to an intellectual and political history thread.

SUMMARY OF POSSIBLE POINTS FOR CONSIDERING THE ISSUE IN AN AMERICAN HISTORY COURSE

1. When studying about American Indians during the Colonial Period, the class could consider the types of toxic substances they encountered. These would include tobacco, wild mushrooms, snake venom, and poisonous plants. In most cases, the toxic effects of all of these substances were recognizable to the Indians except for one. Which one? Naturally, it was tobacco. Students could reflect on why this was the case then. Was it because many people died earlier of other causes during this period than today? Or was it due to the lack of scientific medical research and treatment or to the subtle but cumulative effects of long-term use of tobacco that made it difficult to recognize? Or was it a combination of these possibilities?

The question of how the introduction of new elements might influence the balance or ecology between man and his environment can be raised in relationship to the arrival of Europeans to North and South America. For instance, it has been estimated that by 1650, ten million Mexican Indians had died of European diseases. Why? To what extent could there be ecological parallels with the introduction of certain new substances resulting from industry and technology?

It has been said that society's early view of natural resources was that they were limitless. Students might reflect upon the possible reasons for this view and whether it is human nature to assume this when shortages are not immediately obvious. The questions about consequences of such an attitude and whether it still exists today might be raised. An example from today's society that can be reflected upon is the "oil crisis". Have our views changed as supplies decreased and increased? When the supplies increase, does this mean that we need not be concerned about this natural resource?

Water is another modern example. There is usually a different view of the value of water in the western states than in the eastern ones unless there is a major drought. Are such present-day practices as littering, careless pesticide use, improper disposal of motor oil, burning of leaves and wastes examples of society's early views of natural resources?

2. Methods of disposing of trash and wastes by colonists could become a focus of a presentation or even a study (such as that describe in the project "Waste: Comparing Past and Prsent Cultures" found elsewhere in this publication). Archaeologists have learned much about older civilizations from studying waste and rubbish pits, just as future historians might be able to interpret much from our waste products.

Consideration could be given to why waste from colonial industry could be merely dumped into a pit with apparently no ill effects. The quantity of wastes, of course, was limited by a relatively small population and by British laws that imposed restrictions on colonial industries. And how much hazardous waste was produced by such colonial industries as shipbuilding, brickmaking, and iron making?

3. Students could consider the increased waste from the growth of industry in America following the War of 1812 and the early unhealthy situations for workers in early New England textile mills. During the study of the rise of cities, the increased threat of disease from bad drinking water and nearness of slaughterhouses and leather tanneries can be elaborated upon.

One of the pitfalls of looking at historical developments with hindsight is that we tend to lose sight of the tenor of the time and thus judge the period from a present-minded perspective. To help modify this tendency, the following questions are provided for the teacher to raise and modify as appropriate:

> What were the attitudes of the people to the emerging waste problems? Why? How different were the reasons from those faced by the Indians in the early colonial period and noted in point # 1 above? To what extent were problems the natural results of a rapidly developing economic and social system? Did enough knowledge exist about the problems and possible solutions?

4. How safe were the inventions that were supposed to make life easier? For instance, dyes, inks, and chemicals in patent medicines could all be toxic. Many of the questions raised in the preceding point apply here to keep from judging the period merely from a present-minded perspective. In addition, one might ask: Was there a different standard for safety then? Why? Political, economic,

scientific, intellectual (social), and philosophical circumstances of the period in question can be cited by the teacher.

5. When pioneers went west, especially to the gold fields of California, how did they try to cope with possible spoilage of food? At any time in American history, the question of the safety of metal dishes or glazed pottery could be raised. Was there a problem with "bad water"?

It can be pointed out that although industrial growth was in its infancy before the Civil War, there were some people, mainly in New England, who became disturbed over its implications for society and the environment as they valued it. Some of the views of Henry David Thoreau, Ralph Waldo Emerson and other transcendentalists could be reviewed. Similarities and differences between the views of these writers and those of environmentalists today might be considered along with the circumstances (individual personalities, developments of the period, etc.) that helped shape their respective viewpoints.

6. The degree to which protecting natural resources was a concern during the period of industrial growth after the Civil War can be investigated in weighing values of that time. In so doing, care should be taken to appreciate why the values and priorities were as they were at that time. For instance, such questions could be raised as: Were the attitudes typical of a stage of economic growth? Were they the result of lack of awareness or knowledge? Again, students should remember they are viewing the period with the advantages of hindsight, and future generations, with their hindsight, could be as critical of our values as we may be of other periods.

One of the more obvious points where questions about toxic substances and hazardous wastes can be raised is in conjunction with the muckrakers of the late 1800's. Their contributions can serve as an example of how of how problems of modern society can brought to the public's and lawmakers' attention.

The story can be told of Teddy Roosevelt sweeping the breakfast sausages off the White House dining table after reading Upton Sinclair's book, The Jungle. It also provides an opportunity to study more deeply the role of the media in modern society and the importance of having the skills of critical reading. (Refer to the project, "Reading Skills, Media, and Citizenship", elsewhere in this publication) Without these skills the public might be manipulated by the media with possible negative rather than positive results. That is hysteria might replace reason in addressing the problems. With such considerations, students can become aware of the positive as well as the possible negative potential of investigating or "muckracking" journalism.

7. As the class follows the progress of America into the 20th century, the growth of toxic substances and hazardous wastes can be

dealt with more directly. The background provided by the previous considerations in developing this thread should enhance these activities.

Students can recall specific insights about earlier conditions and compare them with 20th century developments to gain a better understanding of both, including why toxic and hazardous wastes is now recognized as major dilemma facing us today. For instance, scientific and technological developments have increased both the number of new substances and the quantity of wastes as compared to the colonial period noted in point # 1. Advances in science and technology also have made it easier to detect and measure substances and their possible effects. There are more and better statistics kept. Improved communication (including media) is much more of a factor today. Life expectancy has increased thus enhancing the likelihood that long-term consequences of exposure to toxic substances will manifest themselves.

An interesting activity following consideration of such changes as noted above is to have students identify in the textbook and from news reports examples of exposure to toxic substances and resulting problems. Examples would be black lung disease and the effects of mine wastes, auto exhausts, and smoke stack emissions. During the Prohibition era, the use of unsafe raw material, equipment, and other short-cut methods used by the criminal element to save money could be noted. The relationship between the consequences of using illegal liquor, etc. in the Prohibition period and the use of illicit drugs today also could be considered.

8. Starting mainly in the Progressive period laws were passed giving government much more authority and responsibility for protecting the health and safety of the citizenry. This process has accelerated as the problem of toxic substances and hazardous wastes has become more serious. During President Lyndon Johnson's administration the Clean Air Act (1965) and the Clean Rivers Restoration Act (1966) were passed by Congress. The Wild and Scenic Rivers Act of 1968 banned building on sections of eight rivers.

Examples from a rather typical text of topics related to this thread are: "alternative forms of energy", "the Environmental Protection Agency","the Clear Air Act of 1970", "the problem of a polluted Lake Erie", and "dangerous dumps". The positive and negative aspects of using pesticides and herbicides could be noted, including the possible consequences of using Agent Orange in Viet Nam.

Several questions can be raised as the result of all of this legislative activity. Does it represent a growing awareness of the importance of the problem? If so, by whom? The general public? Special interest groups?

Do the laws represent a growing "legislative mentality" (ie. the solution to a problem is merely to pass a law). If so, can this mentality be traced from other periods, say the Progressives, etc.? What problems might such an attitude create? (Some negative consequences might be the following: hastily and poorly written laws; false security that the law will automatically "solve" the problem, and thus no further vigilance is needed; a maze of contradictory, costly regulations that might not properly address the problem.) For a more detailed consideration of the potential and limitations of legislation refer to the project, "Environmental Legislation: Potential and Liabilities", elsewhere in this publication.

PLEASE NOTE

Teachers should be aware that in developing this toxic substances and hazardous wastes thread, some students, especially those in upper elementary and middle grades, may become very upset and frightened about the problem if they are left with the impression that nothing can done about it. It is important, therefore, to end considerations on a positive but realistic note: That is, they should realize that there are steps that can be taken to address the issue, and that citizens must be aware of what is involved to decide on relative merits of the trade-offs. Some of the other projects in the publication such as "Decision-Making: A Simulation" and those mentioned in the above discussion should be helpful in suggesting the attributes and role of responsible citizens.

ACKNOWLEDGMENTS

This revised and edited version was originally developed and evaluated by Frank M. McClary, faculty member of C. Alton Lindsay Junior High School, Hampton, Virginia.

The Vermiculite Asbestos Connection

MAJOR PURPOSES

*To develop awareness of the many uses of vermiculite, its properties, and the possible problems caused by asbestos contamination of vermiculite

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS/QUESTIONS

*To enhance understanding of mining and processing a mineral for its end by-product
*To develop vocabulary and definition skills
*To provide information on the adverse effects of vermiculite use

INSTRUCTIONAL APPROACH

This exercise is based on the article "The Vermiculite-Asbestos Connection" by Dave Pontzer with Alice Cave, (Exposure, December/ January, 1983, pp. 4-5). This publication is available from the Environmental Action Foundation, 724 Dupont Circle Building, Washington, D. C. 20036. The section, "What And Where Is Vermiculite" provides background information on the mineral. Samples of exfoliated vermiculite can be obtained from most greenhouses. Samples of mica can be used for comparison.

It should be noted that the above article represents an environmental action group's point of view on a controversial topic. Exposure of humans to vermiculite contaminated with fibrous tremolite can cause undersirable lung changes. Tremolite may be considered by some as a variety of asbestos.

OVERVIEW

This project is divided into two parts. The first part explores the material itself: composition, source, uses, and direct observation. The second part will explore a possible health threat associatedwith the use of the end product. Vermiculite is contaminated with asbestos, another mineral that is extremely useful, but a very serious health problem.

Asbestos has many very similar uses to vermiculite (insulation, filler, etc.), but its health concerns have been known for some time. Asbestos is a silicate that is easily split into tiny, needle-like splinters. The smaller splinters have been proven to cause serious respiratory problems, including cancer. This has caused the banning of asbestos from practically all uses and its removal from structures, labs, etc.

Vermiculite has moved in to fill many of the gaps left by the removal of asbestos. But there are potential problems, as this vermiculite may be contaminated with asbestos. This necessitates that the students not be exposed to the vermiculite. Make sure that all samples are well sealed.

ACTIVITIES

I. "What and Where is Vermiculite" p. 5

Have students read section. Pass out samples of mica (Muscovite or Biotite). Have students examine with hand lenses and record their observations including a diagram.

Next, hand out sealed test tubes or Petri Dishes containing vermiculite. Observation of the material can be carried out by hand lens. or, even better, by stereoscope. Record these observations and include several of the pieces.

Have students answer the following questions:

1. What is a mineral?
2. What mineral is vermiculite similar to?
3. What is exfoliated vermiculite, and how is it formed?
4. What are the general categories for the use of this mineral?
5. List some specific uses for each category.
6. Why is vermiculite so useful in each of these categories?
7. Make a list of workers and users who would come into contact with this mineral.

II. "The Vermiculite Asbestos Connection"

The students can read the article aloud. Questions to be answered are listed by each section. Some terms have to be explained as they are read (Examples: carcinogen, contamination, ore, hypertension, etc.). These words could be searched for before class, and homework assignment made to obtain a vocabulary list (see partial list at the end of this activity).

INTRODUCTION:

1. What properties make vermiculite such a useful product?
2. List some of its uses.
3. With what is vermiculite contaminated?

"Contamination Revealed":

1. What company first revealed the vermiculite contamination?
2. Where is their ore mined?
   (Explain fibers per cubic centimeter, f/cm3)
3. What is the OSHA standard for asbestos?

"EPA Releases Document":

1. How long has vermiculite been mined in the U.S.?
2. When was the first occupational standard on asbestos set?
3. When were health problems noticed in vermiculite workers?
4. What were some of the symptoms?
5. What is the threshold level of asbestos below which exposure causes no effect?
6. What does this say about an exposure to asbestos?
   (Percentages may need explaining, especially as they relate to possible damage versus exposure.)

"Regulatory Options":

1. What regulatory option does OSHA have regarding vermiculite?
2. Are these options being carried out? Why or why not?
3. What agency would regulate vermiculite in the home?
4. How many people use lawn and garden fertilizers each year in the United States? Install vermiculite insulation?
5. Are products with vermiculite labeled as containing asbestos?
6. What three government agencies know of the vermiculite/asbestos problem?
7. What is the major point the author is making concerning vermiculite use?
8. What could be substituted for vermiculite if it were not available?

SUMMARY

This project could be a general review of what vermiculite is, how it is obtained, what it is used for, the problem that it could cause, and what could be done about it. Discuss with the class whether there is a serious threat to workers and users.

VOCABULARY

Asbestos, carcinogen, contamination, CPSC, EPA, f/cm3,

hypertension, mineral, ore, OSHA, vermiculite

ADDITIONAL REFERENCES

1. There is a wealth of information on asbestos in recent publications. The material found in Asbestos and Health, An Annotated Bibliography of Public and Professional Education Materials, breaks down some literature into several categories. The "Public Education" section will prove most useful for references on asbestos for students. This bibliography was prepared by the Cancer Information Clearinghouse, Office of Cancer Communications, National Cancer Institute, for the U. S. Department of Health and Human Services, Public Health Service, National Institute of Health, 1981. NIH Publication of No. 81-1842.

2. F. H. Pough, A Field Guide to Rocks and Minerals, Houghton, Mifflin Co., Boston, 1976

3. C. W. Chesterman, The Audubon Society Field Guide to North American Rocks and Minerals, Alfred A. Knopf, Inc. New York, 1978

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The Vermiculite Asbestos Connection

By Dave Pontzer with Alice Cave

It's a thoroughly modern product for the lifestyle we've grown accustomed to. Vermiculite is lightweight and non-combustible. It's free-flowing and insoluble, chemically inert, resilient and non-abrasive.

This impressive array of attributes enables vermiculite to insulate, fireproof, extend, lighten, and aerate products ranging from potting soil to concrete, plaster board to kitty litter.

In our *trusting* consumer role we've scattered free-flowing vermiculite about our attic, and we've spread vermiculite-loaded fertilizer onto our lawns. Unfortunately, in our all too frequent *uninformed* consumer role, we've handled vermiculite without knowing that it's contaminated with asbestos, a proven carcinogen.

Contamination Revealed

The vermiculite/asbestos connection went public in 1971. That's when W.R. Grace and Co., the largest domestic supplier of vermiculite, revealed the results of tests confirming asbestos contamination in the ore mined at their Libby, Montana site, producer of 80% of the nation's vermiculite ore.

In 1976, both the Occupational Safety and Health Administration (OSHA) and the Mine Safety and Health Administration got involved when workers in the vermiculite industry came under regulatory "protection" from asbestos dust. Prior to this involvement vermiculite workers were exposed to asbestos dust concentrations as high as 245 fibers per cubic centimeter (f/cm^3). The new OSHA standard of 2 f/cm^3 is even recognized as too high.

In 1979 the Consumer Product Safety Commission (CPSC) acknowledged the contamination problem when they ordered a general study of the use of asbestos in consumer products and included "potting material" (vermiculite) among the products to be tested. However, the scope of the study was later narrowed to include only products in which asbestos is *intentionally* added.

Dave Pontzer, a recent graduate of Georgetown University, just completed an internship with the WaTS Project. Alice Cave is a researcher with an environmental consulting firm.

> **"In 1971, the producer of 80% of the nation's vermiculite announced that virtually all of their ore was contaminated with asbestos."**

EPA Releases Documents

Through Freedom of Information requests Environmental Action Foundation has been able to examine EPA documents on asbestos contamination of vermiculite. These reports date back to 1977.

Although vermiculite has been mined in the United States since 1929, no studies on the health effects of exposure to the mineral have been located. The effects of exposure to asbestos, on the other hand, is well documented.

By 1918 there was enough evidence on asbestos hazards to cause American and Canadian insurance companies to stop selling life insurance to asbestos workers. The cancer-causing potential of asbestos was suspected as early as the 1930's, although the first standard for occupational exposure to asbestos wasn't set until 1971 by OSHA.

> **"32 of the 221 vermiculite workers tested had lung disorders normally associated with asbestos exposure."**

One of the first reported incidences of asbestos-like health problems appearing among vermiculite workers was in 1978 by O.M. Scott and Sons Co., a manufacturer of agricultural chemicals. Workes at their Maryland fertilizer plant developed lung disorders normally associated with asbestos exposure. Of 221 tested, 32 had disorders ranging from fibers in the lungs to bloody pleural effusions, with symptoms ranging from coughing, fatigue and chest pain to hypertension.

The crucial point is that research on asbestos-caused cancer in laboratory animals has shown that there is no threshold level below which exposure causes no effect. Therefore, since no safe levels for atmospheric concentrations of asbestos exist, *any exposure* will produce a percentage of cancers in those exposed.

Regulatory Options

OSHA, under their broad mandate to provide a safe environment for workers, has two regulatory options with regards to vermiculite. The first is an exposure standard and the second a labeling requirement. Theoretically, OSHA's current exposure standards protect workers even after the vermiculite has left the processing plant. But as an EPA report notes, "Realistically, however, it is difficult to imagine the standard being enforced at many of these later sites. For example, it is doubtful that employers at greenhouses where vermiculite is used as a soil conditioner run their businesses with the asbestos standard in mind. Few employers besides those involved in the initial stages of vermiculite processing know that vermiculite is often contaminated with asbestos." This is the case with many other industries using vermiculite as well, including construction workers, drywall installers, brick and stone masons, plasterers, insulation workers, and anyone involved in commercial agriculture.

Why are employers and employees largely unaware of vermiculite's contamination with asbestos? OSHA's labeling regulations for asbestos, ". . . all (asbestos-containing) raw materials, mixtures, containers . . ." covers vermiculite, but the regulation is self-service. Compliance is voluntary as long as ". . . a manufacturer believes that the use (handling, storage, etc.) of a product will not create fiber levels above the OSHA standard." Even this is ultimately a moot point, since OSHA stated in April of 1980 that this exposure standard is insufficient to protect workers' health.

Vermiculite next finds its way into the home, where it is "regulated" by CPSC. The Federal Hazardous Substances Act gives CPSC the mandate to regulate hazards presented by the presence or use of toxic and other hazardous substances in the home. Like OSHA, they have the authority to ban, regulate, or require labels on products.

CPSC has already exercised this authority with respect to asbestos banning two consumer products containing asbestos fiber; artificial embers and spackling compound. Neither is associated with the vermiculite industry. At that time CPSC went so far as to say that there is no safe level of exposure to asbestos in consumer products, and that, "only banning these products can adequately protect the public from unreasonable risks of injury associated with them." As was mentioned earlier, CPSC began a study of asbestos in consumer products over three years ago, excluding products like vermiculite which contained asbestos as a contaminant. To date, nothing has been reported.

CPSC also has the authority to require content labeling of products. In view of EPA reports concerning the significant levels of consumer exposure to vermiculite, this action, at the very least, should have been taken some years ago. A study prepared for EPA by an independent Virginia-based consulting firm makes this quite clear. The report states that, "Over 74 million persons use lawn and garden fertilizers each year. If the fertilizer is vermiculite-based, estimated exposure levels to asbestos of 4.4 ug/m^3* and 28 ug/m^3 could

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*This *weight* method of measuring asbestos exposure (ug/m^3-milligrams per cubic meter) contrasts with the earlier *volume* method (f/cm^3-fibers per cubic centimeter) in the same way that a pound of eggs contrasts with a dozen eggs. Unfortunately, the Virginia study we refer to only used this weight method, and it's virtually impossible for us to correlate the two different systems with the information we have on hand. Further, OSHA only uses the volume method in its asbestos standard. Suffice to say, however, that as the general "rule of thumb" regarding asbestos, there is no safe exposure level, indicates these latter figures using the weight method are all to be considered extremely hazardous.

BEST COPY AVAILABLE

Just When You Thought It Was Safe To:

■ Insulate Your Attic
■ Repot Your Plants
■ Change Your Kitty Litter

result from lawn treatment and gardening, respectively." The report goes on to estimate that 188,000 people a year are exposed to levels of asbestos as high as 13,600 ug/m^3 during the installation of vermiculite attic insulation. 4,230,000 people live in homes insulated with vermiculite.

Additionally, there are at least 3,000 owners of hobby greenhouses whose exposure to vermiculite should be comparable to that of a greenhouse employee occupationally exposed. Anyone repotting their houseplant with potting soil containing vermiculite would be exposed to a small amount of asbestos fiber, as would people who handle kitty litter, barbecue base, or who put up their own drywall, plaster, etc.

The consumer has no idea what's being handled. None of these products, from attic insulation to kitty litter is labeled, CPSC apparently not being sure how to proceed. After the strong stand taken in respect to artificial embers and spackling compound, i.e., no safe exposure level, this inaction is incomprehensible.

The EPA has done extensive research into the problems associated with asbestos contamination of vermiculite, compiling a wealth of information on the subject. As yet they've done nothing with it, issuing no regulations or warnings. It appears that since a safe lower limit for asbestos exposure cannot be found, the problem is being covered up. How else can one explain that at least three government agencies have been studying a known toxic substance, occurring in the market place, for at least five years, and not done so much as require that it be labeled. Another EPA report, also obtained through FOIA, frames the problem:

"Although the quantities of asbestos released during end-use of vermiculite are small in comparison to the mine and workplace, the aggregate risk to the consumer of product end user may be large in view of the large number of people exposed. Moreover, users may be particularly vulnerable and unprotected due to ignorance of the potential hazard."

"EPA has a wealth of information on the asbestos contamination of vermiculite, but has done nothing with it, issuing no regulations or warnings."

Using vermiculite in an enclosed area, such as an attic, greatly increases the exposure level to asbestos fibers in the air. Or a garage. Or a basement. The point is clear, workers and consumers are being exposed to a known hazard without the information to handle it safely, or to avoid it altogether. As the EPA report points out, "There are adequate substitutes for most of the uses of vermiculite. If vermiculite were not available, perlite, cellular concrete and fiberglass would be the most common substitutes."

There the matter now stands. The tragic consequences of asbestos exposure are well established. Vermiculite is a known carrier of asbestos fibers. These microscopic fibers are released into the atmosphere from the time vermiculite is mined through its end use as a consumer product. Yet only the mining and processing of vermiculite have come under any kind of regulation. Upon leaving the processing plant, vermiculite is unregulated, and those handling it are exposed to a toxic substance with no warning as to its presence. ■

Our thanks to Dr. Arthur Rohl, of the Environmental Sciences Laboratory at Mount Sinai School of Medicine in New York, for providing us with critical data and recent studies on the asbestos contamination of vermiculite.

Whistleblower Blues

"An independent group has found that my constitutional right to freedom of speech has been violated and that top officials in the EPA conspired to discredit me and tried to stop me from informing the public and Congress about the failure of these officials to protect the public from hazardous wastes," he said.

—*Hugh B. Kaufmann*, EPA engineer

What and Where is Vermiculite?

Vermiculite is a naturally occurring mineral of the mica family. It occurs in thin flakes packed together in plate-like layers. Tiny droplets of water are trapped between the layers, providing the mechanism by which vermiculite achieves its versatility. Heating vermiculite to between 1,000-2,000 degrees Fahrenheit causes the droplets to evaporate, allowing the mica to expand into small, lightweight, low-density pieces. Pure vermiculite can expand up to thirty times it's original volume. Expanded vermiculite is known as exfoliated and the heating process as exfoliation.

The majority of vermiculite's uses fall into three general categories: lightweight aggregates used in construction, agricultural and horticultural products, and insulation. The building industry uses vermiculite in concrete, plaster, wallboard, and similar material. Vermiculite concrete weighs much less than regular sand-based concrete and has excellent insulating properties. One inch of vermiculite concrete has the same insulating capacity as twenty inches of regular concrete. Mixed into plaster or wallboard, vermiculite adds sound deadening and fire resistant properties.

As insulation, vermiculite is poured loose between attic joists and into hollow cement block. It's also used as a packaging agent to prevent breakage during shipping.

Because of its large surface area and ability to absorb water and gas, vermiculite is used extensively in agriculture and horticulture. Though most familiar as a soil conditioning agent for house plants and in greenhouses, vermiculite is also used as a plant growing medium, chemical fertilizer carrier, packing material for nursery stock, and carrier and extender for pesticides and herbicides.

Vermiculite's other "minor" uses include use as a filler in paints, plastics and rubber, in kitty litter, and in barbecue base (to retain and reflect heat).

Payday for Environmentalists

With every passing public opinion poll environmentalists are getting their much deserved payout for years and years of rallies, teach-ins, press releases, conferences, broadsheets, day-in-day-out meetings, etc, etc.

A recent poll, conducted for the Continental Group Inc., of Stamford, Conn., a major energy, forest products and packaging company is significant because, unlike other polls, it required participants to weigh their support for environmental protection against such possible alternatives as slower economic growth or higher consumer prices.

Based on interviews with 1,310 people selected to mirror the national population, plus 263 corporate executives and 343 members of environmental groups, the survey found:

- 55 percent of those interviewed favor maintaining present air pollution standards "even if some factories close as a result."
- 56 percent favor keeping current environmental regulations "even if it slows the production of more energy."
- 60 percent favor giving priority to environmental cleanup "even if companies have to charge more for their products and services."

Among the corporate executives interviewed, 59 percent from small companies and 51 percent from "Fortune 500" companies said there should be emphasis on cleaning up the environment, even if that required them to raise their prices for goods and services.

The above findings reinforce earlier polls by Louis Harris Associates, which found 83 percent of Americans favor keeping the Clean Air Act intact or stiffening it, in the face of administration proposals to relax standards.

Skill Development In Studying Current Events

MAJOR PURPOSES

- *To encourage the development of questioning and analytical skills
- *To create interest in following current issues in newspapers and periodicals
- *To increase awareness about the prevalence of toxic substances and hazardous wastes as a major issue facing society

RELATED CONCEPTS/UNDERSTANDINGS/QUESTIONS/SKILLS

- *To develop an appreciation of the many facets of an issue
- *To demonstrate the importance of reading for meaning
- *To develop an appreciation for certain considerations that go into selecting test items

INSTRUCTIONAL APPROACH

Bulletin board or scrapbook activities followed by competitive questioning are used to achieve the purposes of this project.

OVERVIEW

This project assumes that teaching about current news should not be limited to a "one-day-a-week" activity, but rather a tool used daily to stimulate interest and otherwise facilitate instruction. The issues surrounding producing and disposing of toxic substances and hazardous wastes have a current and continuing impact on students' lives and have implications for almost any topic in the social studies. As an instructional approach the "follow-up questioning game" has several advantages. First, it channels the competitiveness that characterizes many middle school students into a constructive learning experience. Second, it can help clarify and reinforce insights about the current events. Third, it provides an opportunity to work on the skills of questioning and analyzing.

Being able to recall what is in an article after reading it certainly is a basic learning skill that experienced teachers know cannot be taken for granted. Being able to read for meaning that goes beyond the surface appearance of the headlines of the article itself is an even more valuable skill. This project provides an opportunity to introduce and refine such basic questioning and learning skills so important to developing civic responsibility.

This project's approach could be used appropriately in almost any social studies or science course to introduce the topic of toxic substances and hazardous wastes. Refer to the "Extensions" section of this project for other ideas.

INTRODUCTION TO ACTIVITY

1. Begin the activity by showing students a collection of articles relating to toxic substances and hazardous wastes.

2. Read one or two sentences and the headline from several.

3. Ask students what all the articles have in common.

4. Write answers on the blackboard. Ask for words students might expect to find in these articles -- toxic, hazardous, poison, toxic waste dump, etc.

5. Choose one medium-length article and have students help you write the main ideas/facts on board.

6. Use this information to write a summary.

7. Assign students a one- or two-week project in which they will collect articles from the newspapers, magazines and/or TV and radio spots related to toxic substances and hazardous wastes issues.

8. Have students write brief summaries of these articles practicing the approach introduced in Steps 5 and 6.

NOTE

(This summarizing activity involves identifying and recalling main ideas of the articles. Doing this may be a significant accomplishment for some students, and the teacher may want to refine and reinforce this skill before moving to other levels of questioning. If this is the case, the teacher should go to the next phase of this project -- the questioning competition.

For other students who are comfortable with identifying and recalling, the teacher may want to consider introducing at this point other levels of questioning and learning. These might include interpretation, application, analysis, etc. A consideration and examples of these levels can be found in the book Classroom Questions

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by Norris Sanders published by Harper and Row.

Regardless of which level or levels are addressed, students should be aware of the importance of developing these skills. Certainly the point can be made cogently using the topic of toxic substances and hazardous wastes).

9. Student-summarized articles should be displayed on the classroom bulletin board, and students should be instructed to visit the board regularly as a basis for the following:

a. Have each student prepare a list of five to ten questions based on the articles that they might expect on a test and note why they consider each question worth asking.

b. As a group, have the students survey all the questions to determine collectively which have the greatest value in relation to the topic.

c. Compare the final list prepared by the class with the questions developed by the teacher. Discuss similarities and differences and why they exist. For instance, why did the students consider certain points more important than the teacher did and vice versa? Did the way the teacher worded the questions differ from those of the students? If so, in what respects and why?

Such considerations and questions about questioning help to make salient aspects of this important skill. Such an awareness is too often missing even among older students. Further, students have an opportunity to participate in the process of developing a test. Adding this insight to the students' background should improve the study skills needed not only for preparing for tests but also for reading for significant meaning.

10. The lesson could conclude with the previous activity or proceed to a competitive game using questions submitted by the students and refined during the preceding considerations. Small groups would be pitted against each other. More difficult questions are assigned more points.

As noted earlier, using the game approach builds upon the natural competiveness found among many middle school students. At the same time material is being reinforced. It has also been found that if students know that they are preparing for the competition in the preceding steps, they are likely to have even greater enthusiasm for the activities, since a concrete goal is being pursued.

SUGGESTED GUIDELINES FOR THE COMPETITION

It is important that protocol be clearly established at the beginning of the competition because the ensuing enthusiasm of this age group can result in a breakdown of decorum. The following points have proven helpful:

1. The teacher will read all questions aloud.

2. Students will raise their hands and wait to be called upon. The teacher will determine whose hand was raised first. (See # 7, below)

3. The teacher will be the final judge as to whether questions are correctly answered.

4. The teacher will also determine if the question was answered in an acceptable amount of time. Allow 15 to 30 seconds.

5. Questions are divided according to level of difficulty, in levels of 10, 20, 40, and 80 points. If the students answer the 80 point question, then they may try a bonus question. Bonus questions are valued at 20 points. The entire team may help decide upon the correct answer; only one member of the team may give the answer. First answer is judged; if wrong, the team loses 10 points.

6. In normal questioning (not the bonus round), only the student called upon may answer. If others interfere, give the student more time to complete the answer. Disturbances are penalized with a five-point penalty.

7. Each student will be given numbers (say 1 through 30). A student will be permitted to respond only when his or her number is called.

ALTERNATIVE

An alternative or an addition to the game is to have students keep a scrapbook. In this manner, the students can then classify the articles as an air, water, dump-site issue, or an industrial or transportation problem. The scrapbook could be kept for the entire grading period, a semester, or the entire year.

EXTENSIONS

This project can be a learning activity unto itself -- i.e., to introduce toxic substances as a current issue requiring responsible civic involvement and to develop commensurate skills noted in the purposes and description of the approach. A very worthwhile extension, especially in a history course, is to use the project to introduce the issue early in the course and then relate to it other topics, concepts, etc. that come later in the course. For example, consider how attitudes and concerns about hazardous wastes in different periods of history are similar or different from those that exist today and the reason for the situation.

This approach establishes an important thread or theme that can be nurtured at appropriate points throughout the course, showing how the study of history can contribute to a better understanding of a contemporary issue. For additional ideas on where the toxic substances thread can be addressed in a history course, please refer to the project: "Toxic Waste Instruction in U. S. History Courses".

ACKNOWLEDGMENTS

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NOTES

Risk Versus Benefit: Pests And Pesticides In Your School

MAJOR PURPOSES

*To identify the pesticides used in your particular school building
*To compare the benefits of commercially available pesticides to the risks of insect and rodent infestation
*To illustrate that toxic substances are being used by us and around us daily

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS/QUESTIONS

*To question the relationship between risk and benefit
*To illustrate the extensive use of toxic substances
*To point out the importance and responsibility of proper handling of pesticides
*To provide background information on the cockroach
*To discuss briefly the Kepone Incident that occurred in Hopewell, VA
*To develop skills in acquisition and verification of information
*To initiate critical thinking, problem analysis and problem solving

INSTRUCTIONAL APPROACH

This topic is suitable for a Life Science class at the seventh grade level or a Biology class at the ninth grade level. It also could be applied in grade levels above the middle school. The teacher will present several examples of pesticide use, define pesticides and insecticides and present the idea of risk from use and the benefits gained. Students will be asked to develop a list of the common pesticides sold in stores. Included in the list will be the active agents contained therein, specific target organism(s), and any warnings on the labels. A master list may be compiled in the classroom on posters. A major activity will encourage students to investigate how insects are controlled in their own school and determine what practices are applicable to their particular settings.

Following consultation with the appropriate administrator, students may interview various school personnel and staff. Another approach would be to invite these people into one class to discuss how they prevent and control any pesticide problems. It is suggested that the presentation/discussion be recorded via video-tape so it can be replayed to other classes and stored for future use. Such recordings would reduce the time commitment from some of these very busy staff. Possibly a student and teacher could even interview them at their convenience, recording it on audio tape.

Listed herein are numerous suggestions for student activities as they relate to the topic under study. The teacher will need to pull the minor projects and assignments back together and have some of them reported to the class. In several discussion periods, the class, with the help of the investigative students should draw some conclusions about the use of pesticides in their school. Classes may have different conclusions. A written report could be submitted to the school administration. The school newspaper may want to become involved. A class member may feel it is necessary to present their recommendations and conclusions to the PTA. The teacher should be prepared to handle any controversy that may arise.

OVERVIEW/BACKGROUND

Every school has had a problem with insects at some time or another. If the school serves lunches, or if students and teachers bring food from home, a constant battle must be waged against flies and roaches. Almost all students and teachers in America profess to being disgusted by the sight of insects near eating areas; however, the diseases caused by insects are seldom balanced against the hazard of improper use of insecticides. Neither is desirable. What are the alternatives? Are there any better answers?

These activities will allow students and teachers to investigate how insects are controlled in their own school and to determine what practices are applicable to this specific problem. Emphasis is on proper handling and use. Time of application and alternatives are very important considerations.

The insecticide, Kepone, formerly used in "TAT", an ant killer that was sold in a small flat can with openings for ants to enter, may be used as an example. In Hopewell, VA it got into the environment and also affected manufacturing personnel due to poor production procedures. Kepone is no longer sold or used in this country.

ACTIVITIES

Announce to the students that for this activity they are going to assume the role of an advisory committee to the principal of your school. The principal would appreciate the advice and recommendations of this class on the topic of insect and pest control.

Ask the class to "brainstorm" a list of all locations inside the school building where insects have been seen. This approach should allow students to submit ideas as soon as they originate. No negative remarks should be allowed. All suitable suggestions should be recorded on the blackboard. When the ideas come to an end, begin to rank the locations according to importance. Criteria for ranking may also be solicited from the class or may be provided by the teacher. They could include which location was mentioned most frequently, which locations had the most insects, which locations were the most offensive such as on cafeteria tables during lunch or on clean silverware.... If your school has a very heavy or a very mild infestation of insects, ranking may not be possible.

Have a set of students develop a school map. Identify the locations and attempt to rate the occurrence.

Have students interview the following staff about current methods of insect control: the cafeteria manager, the athletic director, the woodshop teacher, the science department chairman, the principal, any commercial exterminators, the custodians, the groundskeeper....Possible questions for such interviews are:

1. Which insecticides are used in this building by you or a contractor?
2. What are the active ingredients?
3. How often is an insecticide used in your case?
4. Is the control necessary?
5. Is the insecticide effective?
6. Are any special handling precautions used?
7. When during the day or year is this treatment done?
8. Who decides that the treatment is necessary?
9. What are the alternatives to insecticide treatment?
10. Where do the insects and pests originate?
11. Is insect control a requirement of the health department or a government agency?
12. Others......

In lieu of an interview, these resource people could be invited into the classroom to give the same information to the entire class. As noted previously their time is quite valuable and an audio or video recording should be considered.

Most institutions and households control insects by use of one of the following agents:

BRAND NAME	ACTIVE INGREDIENTS
PT 150	pyrethrins
PT 240	boric acid powder
Ortho Pest-B-Gon Roach Bait	2% Propoxur,[-(1-methyloxy)phenyl methyl carbamate]
D-CON	0.5% Propoxur 0.237% 2-2, dichlorovinyl dimethylposphate
D-CON Double Power	0.075% pyrethrins
Ortho Earwig, Roach, & Sowbug Bait	2% Propoxur
Raid Roach Tape	4% Propoxur
Ortho Flying & Crawling Insect Spray	0.25% Resmethrin
Ortho Home & Garden Spray	0.25% Resmethrin
Ortho Home Pest Killer	0.5% Diazinon
Ortho Diazinon Insect Spray	25% Diazinon (outdoors only)
Ortho Hi-Power Household Insect Fogger	0.3% Allethrin 0.19% Phenotrin

Other Activities:

Student teams can determine which businesses sell pesticides and who are the major national manufacturers. They can also determine via the telephone book and advertisements, who are the commercial pesticide businesses in your area. Possibly one of your student's parents may be involved here and would be willing to come to the class to present this aspect of his business.

A student team per class could develop a list of pesticides commonly sold or used. This could include the target organism(s), the active agent (s), and any warnings on the containers.

Assign several students to be become experts on the most bothersome insects or pests such as the cockroach, Japanese beetles, termites, mice, rats, bats, gypsy moths, ants, slugs, fleas, silverfish, crickets......

A student should interview the local extension agent regarding the topic of pesticides.

Ask each student to read an article on pesticides. They may want to solicit the help of the librarian and use "The Readers' Guide to Periodical Literature." Listings that may be good to pursue include: aldrin, dieldrin, chlordane, DDD, DDT, DDE, endrin, heptachlor, lindane, kepone....

Since kepone is an insecticide which was produced in Virginia and a few other states and it became famous overnight due to the careless handling of the substance during manufacture, this unit has included later additional information on this particular insecticide and incident. Many students will recognize the name, "kepone" as something bad, but have no knowledge of its properties, uses, or the actual situation surrounding its notoriety. We use it only as a familiar example to illustrate the suggestion that we must take some of the responsibility for our own health and safety and that improper handling of any toxic substance may endanger others who are unaware of that danger. We would also suggest that learning the details of the kepone tragedy and other instances of the improper handling of insecticides would be an excellent spring-board for discussion leading to the development of values, ethics, ecology... while also furthering the scientific understanding of chemical use in every-day life.

Included also for information is a general background summary about cockroaches.

CONCLUDING AND CULMINATING ACTIVITIES

Using the interviews, student reports, guest speakers, periodical article reports, lists of pesticides, risk and benefit discussions.... conclusions need to be drawn by the class with the help of the teacher. The following questions should have been answered:

1. What is the extent of the insect and pest problem in your school?
2. By whom is the problem being addressed currently?
3. Are insecticides being used? If so, are they being used properly? Are they effective?
4. Are there any precautions that are not being taken which should be implemented?
5. What alternatives are available?

It is suggested that the class as a group or several teams write reports based on their recommendations.

SUPPLEMENTAL MATERIAL ON THE COCKROACH

Kingdom: Animalia; Phylum: Arthropoda; Class: Insecta; Order: Orthoptera; Family: Blattidae.

The cockroach is one of the best known and most successful household pests in America. They existed as a family of insects as long ago as the Carboniferous Period of the earth's history (250 million years ago). There are over 2,250 modern species, most of which are found in the tropics. Three or four species make up the populations regarded as household pests.

Roaches are insects, having six legs, two pairs of wings and three distinct body sections: head, thorax, and abdomen. They also normally have antennae which are sensitive to both pressure and moisture, maxillary palpi (paired mouthparts) which are sensitive to chemicals, and sensory hairs which detect vibrations. The exoskeleton is covered by a layer of oil and wax (the cuticle) which protects against dehydration. The mouth of the cockroach is used only for ingesting food; oxygen enters and carbon dioxide exits the body through tiny openings on the lateral surfaces of the abdomen. These spiracles lead into the branching network of air tubes called tracheae and eventually into air sacs where gas exchange takes place.

In the order Orthoptera, roaches are related to the grasshopper, preying mantid, cricket and the walking stick. These all have chewing mouthparts and incomplete metamorphosis. The eggs of most roaches are deposited in a capsule (the ootheca) which may contain 10-40 nymphs depending on the species. The nymphs resemble the adults but are smaller and lack wings. They eat, grow and molt several times during the juvenile stage. When the exoskeleton is shed, the cockroach is unprotected for about eight hours as a new exoskeleton hardens.

Only four species of cockroaches are considered major household pests in the USA. The most common of these is the brown German cockroach *(Blatella germanica).* Growing to approximately 1.5 cm long, *Blatella* has two dark stripes on the thorax and has a life cycle of only 14 weeks. The American cockroach *(Periplaneta americana)* is reddish brown with lighter markings on the thorax. This roach grows to approximately 2 cm long and has a life cycle of 16 months. While *Blatella* is frequently found in kitchens and bathrooms, *Periplaneta* is often found in basements and on large ships near pipes. The oriental cockroach *Blatta orientalis,* is sometimes called a water beetle or waterbug. It grows to about 2.5 cm long and is dark brown or black. The male has wings but does not fly, the female has only rudimentary wings. This roach also can be found in damp, dark basements where it may climb pipes to the upper floors and be found in or around sinks or bathtubs. Its life cycle is 12 months. The brown-banded cockroach, *Supella supellectilium,* is slightly different in coloring from the German roach. The two are the same size and could easily be confused. The brown-banded roach has a life cycle of about 11 months.

Cockroaches in general are omnivorous scavengers. Some species appear to prefer starch materials and meat products, but as a group, the household roaches will eat such diverse foods as: their own cast-off exoskeletons, bedbugs, clothing, feces, book bindings, leather and sputum. Roaches are more than a nuisance to humans. They pick up viruses, bacteria and other pathogens in their environment and carry these microbes in their digestive systems or on their bodies. Cockroaches have been known to carry polio, typhoid, food poisoning and leprosy. Most of these diseases carried by cockroaches to humans are due to improper handling of sanitation procedures.

In the USA, the cockroach continues to be quite successful in spite of our elaborate and expensive control measures ranging from insecticides, boric acid, bay leaves, paper traps, sound generators to aerosol bombs. This measure of their success is due in part to the prolific breeding and short life cycle of the most common roaches. The cockroach is also protected by its instinctive habit of testing foods with its maxillary palpi before taking that food into the digestive system. Foul tasting poisons are never ingested. Roaches also have the advantages of special sensitivity to vibrations and exceptional speed.

Americans have tried several different chemical means of controlling roaches; however, those chemicals which are most successful in eradicating roaches have also been the most dangerous to humans and our pets. These chemical agents enter the spiracles, are ingested or are contact poisons. Small amounts of these agents often affect the nervous system of the insects.

SUPPLEMENTAL MATERIAL ON KEPONE: AN INSECTICIDE HANDLED CARELESSLY

At one time, not too long ago, roach and ant traps used in the USA might have contained 0.125% chlordecone (Kepone), a chlorinated hydrocarbon similar to chlordane, aldrin, dieldrin, and endrin. Chemically, it is $C_{10}Cl_{10}O$. Kepone has a low vapor pressure and degrades slowly. A white powder in its pure form, it decomposes at 350 C and is only slightly soluble in water or hydrocarbon solvents. It is soluble, however, in alcohol, ketones and acetic acid and it has an affinity for lipids; therefore, Kepone is bioaccumulated through food webs.

In 1950, employees of Allied Chemical Company applied for a patent for the insecticide, Kepone. It was first registered as an insecticide with the USDA in 1959. In 1958, Allied entered into a contract with the Medical College of Virginia to study Kepone and its effects on rats. The study continued until 1961. From 1963 until 1965, Kepone was manufactured by Hooker Chemical Company and sold to Allied. In 1966, Allied began manufacturing Kepone at its large plant in Hopewell, VA. The majority of the Kepone produced was not being used in this country but in Europe. Therefore, in the 1970's, as America became aware of environmental insults and legislation was passed to protect our citizens, our air and our water, Kepone was low on everyone's list of potentially dangerous chemicals that required testing and classification.

As demand for the insecticide grew, Allied stopped manufacturing Kepone and Life Sciences Products (LSP) was incorporated. In the first months of 1974, LSP began producing Kepone in a former gasoline station building within sight of the large Allied complex. LSP bought their raw materials from Allied and sold all of the Kepone produced back to Allied. Kepone was their only product. LSP was in operation for less than two years. In July, 1975, LSP stopped work at its plant - two days before the Virginia Department of Health would order it closed.

What went wrong? In spite of the fact that Allied had commissioned safety testing of Kepone by the Medical College of Virginia in 1958, and in spite of the results of a a 1972 toxicity test of Kepone run by the National Cancer Institute, those people involved in the manufacture of this insecticide handled their product and their waste material in a very lax manner. Perhaps, the average employee was not aware or not convinced of the potential dangers.

Both Allied and LSP allowed some of the insecticide to enter the James River at Hopewell through the municipal water treatment plant and occasionally directly into the river. The employees at LSP were exposed to 3 mg/m^3 daily. Their clothing, shoes and skin were literally dusted by Kepone each day and they wore no respirators. They wore the insecticide home on their clothing.

From March, 1974, until April, 1975, the EPA air monitoring station recorded that 40% of all airborne particles 200 yards from LSP were Kepone. There was an ice plant nearby which sold ice during that year which contained Kepone in concentrations ranging from 0.1 - 1.0 ppm. In February, 1974 EPA cited LSP for not having an air pollution permit. They bought a baghouse (air filtration system) in October of that year.

The first problem with water pollution was noticed as the Kepone was leaking into the Hopewell municipal sewage treatment plant. The secondary treatment plant had a bacterial digester and the Kepone from LSP was killing the sewage-decomposing bacteria. Raw sewage, including Kepone, had to be dumped into the James River. The James River flows into the Chesapeake Bay, one of the most productive estuaries in the world.

The City of Hopewell requested toxicity data on Kepone from the EPA and EPA set a limit of 0.4 ppm Kepone for any water flowing into the waste water treatment plant. In July, 1975, Hopewell's waste water permit was amended to require that LSP pre-treat waste water before it entered the municipal plant, but LSP closed before any effort was made at compliance.

In September, 1974, an employee of LSP filed a complaint about conditions at LSP under the Occupational Safety and Health Act. A subsequent investigation drew the conclusion: "no severe hazard". However, in July, 1975, another employee, visiting his family physician complained of nervous tremors and an unexplained weight loss, began a chain reaction that led to the closing of the plant, interviews and examinations of all employees and many of their friends and family members, and criminal and civil court cases involving fines and out-of-court settlements in the millions of dollars.

In May, 1976, Allied Chemicals, LSP, and the City of Hopewell were indicted on 1,096 criminal counts including defrauding the EPA and violations of federal water pollution laws. In October, 1977, a federal district judge in Richmond, VA, fined Allied Chemical 13 million dollars. Allied and LSP had pled "no contest" to 940 counts of pollution of the James River in connection with the manufacture of Kepone. Two hundred million dollars in damages were filed against one or both of the companies by former employees and by local fishermen whose livelihood was damaged drastically when the James River was closed to commercial fishing. Today, in 1984, more than eight years after the closing of the plant, commercial fishing is still banned for most species of fish during some part of each year. The levels of Kepone found in samples of fish taken from the river in 1982 were higher than the levels in 1981.

When the employees were first examined in July, 1975, many of them were found to have high levels of Kepone in their body fat, liver, testes and blood (7.5 ppm in blood). The symptoms displayed in the employees to varying degrees were the same as the symptoms found in mammalian test for toxicity using rats and rabbits which were done earlier at the Medical College of Virginia. The symptoms were: tremors, ataxia, skin changes, hyperexcitability, hyperactivity, muscle spasms, testicular atrophy, low sperm count, estrogenic irregularities, sterility, breast enlargement, liver lesions, cancer of the liver.

The symptoms apparently were caused by: disruption of ion movement across the axon membrane of nerves, inhibition of the enzymatic function of ATPase, and inhibition of enzymatic role of acetate dehydrogenase in muscles.

Fortunately, researchers at the Medical College of Virginia have identified a drug, cholestyramine, which accelerates the rate at which the human body can excrete Kepone. No such satisfactory procedures have been found to remove Kepone from the river or to protect the seafood industry. Since the Kepone-contaminated sediment does not dissolve significantly in water and degrades very slowly, Kepone will remain a significant source of water pollution in the James River for years to come. Dredging would be too extensive and expensive.

Ignorance coupled with carelessness is a deadly combination when handling insecticides. Kepone is chemically a relative of DDT. Americans have suffered from ignorance and carelessness in connection with both. However, both chemicals are insecticides which served a purpose and continue to serve in other countries: aiming at preservation of health and safety. Which is more dangerous, insects or insecticides? If we are to continue to operate in ignorance and handle dangerous chemicals carelessly a similar senario will be repeated endlessly. As we learn more about the properties of such chemicals, hopefully we will begin to give them the respect they deserve.

VOCABULARY

Pesticide, insecticide, poison, risk versus benefits, kepone, DDT, bioaccumulation, food web

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Land Use: Rights And Responsibilities

MAJOR PURPOSES

*To examine the relationship between land use and the "quality of life"
*To become familiar with governmental decision-making processes
*To consider possible short-term gains versus long-term consequences
*To consider the relationship of citizens' rights to responsibilities

RELATED CONCEPTS/UNDERSTANDINGS/QUESTIONS/SKILLS

*To consider the influence of citizens and pressure groups
*To practice the skills involved in making decisions
*To increase awareness of human effects on the environment
*To examine the importance of public awareness

INSTRUCTIONAL APPROACH

A simulation is used that enables students to form lasting impressions of complex issues involved in making decisions about the potential costs and benefits to the community of a billion-dollar mining operation. The project takes approximately three days. Students participate in role playing which allows each one to study in depth one aspect of the larger issue and then to learn from the other students about additional roles and viewpoints.

OVERVIEW

Each new generation receives its environment from the previous generation. Each has the responsibility to the future to hold the land, water, and air in trust.

The decisions made by private and government agencies concerning land use are of vital importance to honoring this trust. An informed citizenry is crucial in this process. This project uses a simulation to help students become better informed and thus better prepared for their responsibilities.

The role of the citizen in government and industrial planning is complex. Questions concerning citizens' rights and responsibilities are important subjects which should be considered: How does land use and misuse affect the quality of life? What is the role of the citizen in government and industrial planning? How are individual rights balanced against the rights of the group (public and private?) In what ways should citizens be involved in long-range decision-making processes?

INTRODUCTORY ACTIVITY

1. Secure from the public library (or produce your own) a tape recording of the following two sets of sound effects:

   a. birds chirping, frogs croaking, streams gently gurgling, children laughing at play

   b. trucks revving their engines, whistles and construction noises, earth-moving equipment, etc.

2. Have students write a brief statement of how they picture the sounds; what scenes the sounds led them to create in their minds' eye; what emotions (if any) they felt.

3. Use these descriptions as a lead-in to consider land use: recreation, natural habitat, industrial development, etc. Have students discuss advantages and disadvantages of various forms of land use. Lead discussion to include viewpoints of the characters from the simulation.

(Refer to this project's Appendix I for a description of the characters' roles)

DAILY ACTIVITIES

DAY 1:

Students should be assigned their role cards and given enough time to become familiar with their character and to familiarize themselves with the situation being depicted. Because the project considers historic, health, social, and economic issues surrounding land use, background information should be provided to each student.

(Refer to project Appendix II for background information)

NOTE ABOUT TEACHER'S ROLE: The teacher must be mindful of his/her role during a simulation...as a facilitator but not a judge or an informant. It is important that students arrive at their own judgments within the framework of the simulation. The teacher should refrain from providing the "right answer" to questions but rather allow the students to arrive at their own conclusions.

DAY 2:

Actual Board meeting: The panel should elect a chairman who will function as moderator throughout the meeting. Testimony from local citizens and others should be heard in an order decided by the panel. Each witness should be allowed several minutes (about 3 to 5) depending on your time constraints, to give his prepared statement and to answer any questions from the panel.

After all testimony has been heard, the panel will consider its decision and prepare a general statement to be read the following day.

DAY 3:

The panel will read its decision and supporting statement and the teacher will lead the class in a debriefing session. For your convenience suggestions about debriefing noted elsewhere in this book are included at this point:

The real learning from any simulation occurs in the post-game debriefing discussion. The intense involvement experienced by most students during the simulation precludes any objective reflection during the activity. Only after the simulation has been completed can the teacher assess student learning. The heart of the simulation is the debriefing/learning experience. It is, therefore, of paramount importance that the teacher understand effective debriefing techniques.

EIAG Model Debriefing

One of the most effective debriefing techniques is the EIAG model:

Experience: "Do" -- explain the game experience.

Identify: "Look" -- be descriptive.

Analyze: "Think" -- be analytical.

Generalize: "Learn" -- draw conclusions.

By following such a model the teacher may be more successful with simulations as an instruction strategy. However, the teacher must remain aware that this is simply a model which must be adapted to fit the individual situation. The teacher must create a non-threatening environment which allows the students to discuss freely their feelings and emotions. In most cases the students are anxious to discuss what happened and the teacher needs only to keep the discussion focused and moving.

Examples of Debriefing Questions

Here are some examples of debriefing questions using the EIAG model:

1. Experience: Who were you? How did you assume your character? What aspects of the character influenced your decisions?

2. Identify: What were you trying to do? What was the most significant thing to you? Why?

3. Analyze: How did you meet problems? Do you see any relationships between characters and actions? Why did certain events occur?

4. Generalize: Did you learn something from this experience? Can you draw any conclusions about how businesses and individuals act?

APPENDIX I

ROLES

The following roles are examples and can be modified to represent special situations in a community. The number of roles can vary so that every member of the class has a role to assume. The Advisory Board of Supervisors should be an odd number to insure a decisive vote. This panel will hear testimony and decide whether or not to allow the proposed mining operation to begin. They should prepare a statement supporting their decision.

A role card should be made for each participant. If need be, modify the vocabulary so that it is appropriate for the class.

REAL ESTATE AGENT: Married with three children, lived in the community for five years. Business has been slow due to recession and high interest prices. Mining company would need to buy land for use as housing for employees as well as property adjoining mine for support buildings. Proposed operation would mean financial security for agent.

MINISTER: Married with grown children living away from home. Born and raised in community. Opposes mining operation. Sees influx of miners from outside area as destroyers of rural nature of area and a "bad influence on our youngsters".

LANDOWNER: Married with two children and four grandchildren all living in area. Supports mining operation because would insure financial independence of entire family, create alternate energy source so that future generations would not be dependent on foreign oil, would create much needed jobs for area.

RETIRED PERSON: Widow, no children in area. Opposes mining operation because it would bring in too many new people. Retired in this area because of quiet, rural nature of the community.

HISTORICAL SOCIETY REPRESENTATIVE: Opposes mining operation because some home of historical value might be destroyed. Has worked many years to have area listed as historical for preservation.

ENVIRONMENT GROUP: Opposes mining operation because mining operation would destroy local ecosystem, cause possible air, water, and ground pollution.

LAWYER: Supports mining operation because increased productivity would help community financially. Has two children in need of jobs for college money. Also cost of litigation for community to attempt to stop project would be a financial burden on taxpayers.

FARMER: Married with one child. Opposes project because an access road would cut through his property and decrease land use. Water supply for irrigation would be destroyed.

UNEMPLOYED WORKER: Married with four children. Supports mining operation because it would create jobs other than as a miner. Support industries and increased business in community would also create jobs.

UNEMPLOYED MINER FROM OUTSIDE AREA: Married with three children. Supports mining operation because mining industry is depressed and many miners are out of work. Miners are "good people" who need jobs to support their family. Would be an asset to the community.

OTHER POSSIBLE ROLES: The following are ideas for additional roles that could be used to increase participation: Mining Company Representative, Government Agency Heads, Scientists, Local Representative to State Legislature.

APPENDIX II

BACKGROUND INFORMATION FOR CENTERVILLE SIMULATION

Centerville is in a predominately rural area with gentle rolling hills and clear streams. Located within the area are houses dating back to the colonial period. People live in these homes and their unique designs are of interest to many people. The area also has a summer camp that is extensively used by outside groups and people within the community. Although it is a rural community, many people supplement their farm incomes with jobs in the textile, rubber, furniture, and other industries located in the area. Within a fifty mile radius there are 650,000 people.

Within the immediate vicinity of the camp and the historical houses, a mining company has discovered a rich deposit of a wonder mineral. The deposit has an estimated value of one billion dollars and the development of the deposit could make the U.S. less dependent upon foreign sources for this strategic material. This deposit is located on a tract of land containing one hundred and eighteen acres. The land is owned by three area farmers and the churches that operate the camp. The owners of the land are expecting to receive about forty-two million dollars for their mineral rights if the mining is permitted. The company has 40,000 acres of land upon which it has the right to explore. The landowners that leased the 40,000 acres were given a sum of money.

ISSUES RAISED BY THE PROPOSED VENTURE

1. Real Estate Values: The possibility of some property increasing in value, while other property could suffer a reduction in value depending upon how the property was used.

2. Health: Research indicates that there are health risks associated with mining. New safe-guards and new technology are now being used. The degree of risk and effectiveness of new technology are debatable issues.

3. Waste Disposal: The questions of waste disposal and its effect upon the environment will have to be addressed.

4. Vegetation and Wild Life: Will the dust from the mine and the water that has been used in the venture pose any threat to the plant and animal life?

5. Employment: New jobs will be created in the venture and in related industries. The possibility of unemployed miners from other areas coming into Centerville exists. Boom and bust cycles are

typical in mining operations. What happens when the mine is closed?

6. Effects Upon Other Communities: The possibility of water pollution is a concern of other communities. With the inter-basin transfer of water, larger areas are involved. If the state grants a permit for mining in Centerville, the same type of mining might take place at a future time in other parts of the state.

7. Historical Issues: Should architectural designs and examples of workmanship of past generations be preserved? If so, what are the possible trade-offs, and are they acceptable?

8. Property Rights: the state has allowed millions to be spent in exploration. Does the state have the right to deny the right of the stockholders to get a return on their investments? What about the possibility of a decrease in property values in the surrounding areas?

9. Religious, Civic, and Family Relations: Wise use of resources is a civic and religious concern. The problems arise when the decision has to be made about the trade-offs in the development of resources. Which represents the best stewardship of a piece of property, the preservation of a lush green meadow or the development of an energy source?

10. Media: Vested interest and the element of sensationalism makes it necessary for the people to examine carefully their sources of information. How will special interest groups such as environmentalists and business groups influence the media?

11. Legal Services: Legal services will be needed in the sale and leasing of property, and in the protection of property rights. Which right should be protected, the right to develop a valuable resource or the right to maintain the present environment?

12. Education: The community will have to provide adequate buildings, additional teachers and an expanded bus service. What happens after the mining is completed and the people move?

13. Regulation: Who will regulate the industry and monitor environmental quality during mining operations? Who pays for this? Who will be responsible for monitoring the environmental effects many years from now when minding has ended?

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Waste: Comparing Past And Present Cultures

MAJOR PURPOSES

- *To examine historical uses of the environment
- *To compare selected values of two cultures

RELATED CONCEPTS/UNDERSTANDINGS/QUESTIONS/SKILLS

- *To appreciate the importance of citizen involvement in decision making
- *To consider the relationship between man and environment
- *To consider the interdependence of individual regions and larger geographic areas
- *To develop historical-mindedness by increasing awareness of the colonists' life-style in Virginia
- *To develop insights into how scholars arrive at conclusions or generalizations about historical mysteries
- *To see how comparing two periods of history can help increase understandings about both
- *To recognize the responsibilities when using comparisons in making judgments about present or past events.

INSTRUCTIONAL APPROACH

This project uses a case study to compare similarities and differences between the way 17th century Virginia colonists discarded trash and 20th century Virginian citizens are addressing the task. There are two lessons -- one devoted to each period. The first deals with colonial settlement of Wolstenholme Town; the second focuses on the kepone contamination of the James River.

The materials needed are the following:

1. A wall map of Virginia

2. Teacher-duplicated materials of two waste dump situations. Articles on Wolstenholme Town are found in two issues of the National Geographic magazine, both by the renowned archaeologist and historian, Ivor Noel-Hume. The pertinent issues are June 1979 and January 1982. An article on the kepone issue can be found in the National

Wildlife Federation publication, The Toxic Substances Dilemma - A Plan for Citizen Action. Another source on the kepone issue is entitled "Kepone: A Chemical Disaster in Hopewell, Virginia", by Michael Reich and Jacqueline Spong, published in the International Journal of Health Services, Volume 13, No. 2, 1983.

OVERVIEW

The Virginia colonists of the 17th century and Virginians of the 20th century have in common, among other things, a need to dispose of their trash or waste. There is, however, a difference in both the nature of the trash and how it was and is being handled. The colonists did not have the urgent, even potentially fatal, problem of waste disposal faced by modern societies.

The relationship between man and his environment is a complex issue which has been faced by many preceding generations. At no time in the past has an awareness of this relationship been more important than it is today. Comparing the past with the present enhances the appreciation of both periods' attitudes toward the environment. This is an aspect of intellectual history, which is often not considered in the middle grades. But by using hazardous waste to consider man's relationship to his environment, not only are students having a chance to reflect about an important thread in history and a pressing contemporary problem, but also to develop a "historical-mindedness" about the colonial period.

LESSONS

In these lessons, the settlement of Wolstenholme Town (as described by Ivor Noel-Hume in the two articles noted earlier) is compared with the dumping of kepone and raw kepone waste into the same James River on which the Wolstenholme settlers placed themselves in the early 1600's. It will be helpful to point out to students that they should be aware that using hindsight in evaluating the settlement can cloud an accurate understanding of the case study.

Lesson #1:

1. Begin the lesson with this question: "Would you be surprised if I told you that a historian is often a garbage man -- sifting through piles of waste for clues?" Then ask: "Have you ever heard of college professors searching for and studying piles of trash or rubbish?" This should lead into a discussion about archaeologists.

2. Pass out copies of the reading materials about Wolstenholme Town along with lists of questions (see below). Explain that they are to

search for clues concerning ways an archaeologist or historian looks for facts about an ancient civilization in trash piles.

3. Have students use the wall map to draw a map showing where the two locations (Wolstenholme Town near Jamestown and Williamsburg and Hopewell where kepone was dumped) are in relation to each other.

4. Assign students a list of prepared questions to answer (see suggestions below).

5. Conduct an oral follow-up to the lesson to get student reaction to the ideas addressed with the questions.

Some Suggestions For The Teacher And Students:

Both articles on Wolstenholme Town are very good sources for the teacher and students. Mr. Hume has also written a fascinating book on the subject entitled Martin's Hundred which could also be used. There are many references in the magazine articles that relate to the trash dump issue. Here are a few:

1. "There the land surface had been turned over time and time again, destroying the accumulation of layers of soil and refuse that man leaves behind on his homesite." June, 1979 issue, page 787.

2. "...where residents discarded bits of bottles and pottery -- datable trash indicating occupation between 1625 and 1645." June issue, 1979, page 745.

3. "In one of the site A rubbish pits, ...(was) found an inch long scrap of woven gold." June, 1979 issue, page 748.

Other clues revealed by the trash dump include finding a skeleton of a woman who had been badly injured and scalped in the 1622 massacre. The historians and archaeologists speculate that she crawled to a rubbish pit to die.

Some suggested questions to consider:

1. Were the colonists concerned about the effects of their trash on the environment?

2. Why is the modern historian not fearful of possible contamination he might receive from investigating an ancient dump site?

3. What types of waste were thrown away?

4. Why would the colonial trash dump not tell us all there is to know about older types of tools, utensils, pottery, and weapons used then?

5. Why is the quantity of waste small, even for so small a community?

6. What are some of things that scholars do in making judgments about what the items in trash dumps indicate about the period?

Lesson #2:

This lesson builds upon the concept established in the first lesson -- that the trash or waste generated by society can reveal to scholars things about events and the outlook and life-style of the people at that time. Students will have a chance in this lesson to speculate on what future scholars might conclude about our society based on evidence (written or surviving trash) discovered about the kepone pollution of the James River.

As a basis for the speculation, have the class assume that the following description was found among other evidences of the incident such as remains of the clean-up effort at Hopewell:

> "The pesticide kepone was produced by Allied Chemical Company beginning in the early 1940's but was not produced at Hopewell, Va. until 1965. By 1974 production was switched to Life Science Products Company (LSP), formed by two ex-Allied employees. A converted gasoline station near the Hopewell Allied plant was used to produce the kepone. Allied supplied the materials; LSP produced the final product and Allied took it back.
>
> "At Life Sciences, workers were careless about how they handled the pesticide. They were making chemical grade kepone, which would be used in a final product for the consumer as a 5% compound for ant poison. The kepone was all over the plant. Dust was into the workers' clothing. Enployees sometimes took the substance home for use as a pest control. Some wastes were thrown into the water feeding the James and dumped directly into the sewage pipe leading to the Hopewell sewage treatment plant. This action caused the sewage digesters to break down at the treatment plant.
>
> "Workers became ill and took it for granted. Eventually, one worker's illness was reported by a physician to the Virginia Health Department. The cause was exposure to kepone. The EPA eventually came in and conducted a clean-up of the plant site. The James River is no longer a major source of commercial fish because of the potential effects of kepone on humans."

Based on this description and other evidence that the teacher might introduce about the incident (see The Toxic Substances Dilemma mentioned earlier and listed in the Reference section of this project) and our society, have students brainstorm what future scholars might conclude about us. What are some of the similarities with the Wolstenholme Town findings? What are differences? (*vis à vis* lifestyle, human nature, values, etc.)

Some other questions for consideration are:

1. Why couldn't Life Science and Allied companies treat their wastes as the people at Wolstenholme Town had done?

2. Why was it safe for the archaeologist to dig in the rubbish of an ancient pit?

3. Can the future scholars feel as safe when exploring our disposal sites? Why? (long half-life of chemicals, etc.)

Some vocabulary words to use:

historian

rubbish

environment

regulation

silt

kepone

archaeology

potsherd

toxic

estuary

EPA

half-life

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(Wolstenholme Town and Martin's Hundred are in the same general area, so this fascinating volume can be used for additional insights about the period and the methods of archaeological excavation and research. One reviewer said "With all the wiles of a mystery writer, Noel Hume maintains suspense for his readers until the last page of his story.")

ADDITIONAL NOTES

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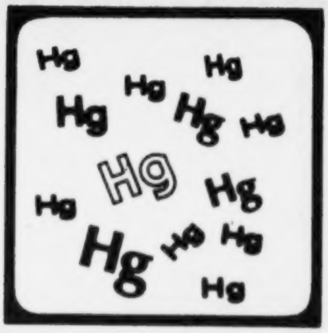
Mercury Pollution And Simulated Production Of Methyl Mercury



MAJOR PURPOSES

*To provide an introduction and background to mercury pollution
*To provide examples of mercury contamination of river water
*To present the damage to biological systems caused by mercury
*To simulate the production of methyl mercury

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS/SKILLS

*To illustrate the pollution problems in Virginia rivers due to mercury
*To simulate mercury chemical derivative formation
*To report on the damage mercury pollution has caused
*To illustrate how wide-spread mercury contamination can become
*To present the dangers of toxic mercury
*To present some of the chemical and physical characteristics of mercury
*To present a situation where the pollutant is not readily collectable

INSTRUCTIONAL APPROACH

This lesson is suitable for Life Science, General Science, Physical Science, and Earth Science classes. It consists of general background information about mercury and some specific examples of mercury contamination of two rivers in Virginia. Since methyl mercury is the toxic agent to most biological systems a simulated chemical reaction using steel balls, olive oil and bile enzymes are used to safely represent what now is known to happen to mercury or quicksilver as it remains in contact with river water and bacteria. The latter can be a teacher demonstration or student teams can conduct the study depending upon the volume of supplies available.

Although Saltville is the home of the nation's first salt mine, it is also one of the most notorious mercury contamination sites and is a Superfund project that is nearing completion. This multimillion dollar cleanup continues to make the newspaper, and students should be able to collect current articles about this specific site or even other examples of mercury contamination. Possibly the progress could be followed as such sites are reported and cleaned up. It is also suggested that a map having the rivers of Virginia or the mid-Atlantic states be available. This could be a road map or one borrowed from the geography teacher.

Another aspect to follow would be the new standards for mercury contamination in water as adopted in September, 1983 by the State Water Control Board. These would be one-fourth the EPA limits. Total mercury would be 0.005 parts per billion (ppb), methyl mercury limit of 0.01 ppb and a freshwater sediment limit of 300 ppb. A revised portion of the regulation calls for mercury concentrations not to exceed 750 ppb in fish. The level in fish will be subject to periodic sampling.

It is also suggested that a biologist from the State Water Control Board Office be asked to visit and update the status of the standards as well as the progress and developments at the mercury contamination sites, the North Fork of the Holston River at Saltville and the South Fork of the Shenandoah River below Waynesboro.

OVERVIEW/BACKGROUND INFORMATION

In 1981, the Environmental Protection Agency released the results of a study which had been mandated by a 1976 federal court order. The study identified 12 toxic pollutants which researchers felt would require more stringent controls than those being exercised currently. The controls were said to be necessary to protect human and aquatic life. Mercury was high on that list. The EPA study also identified the Holston River, near Kingsport, Tennessee, as one of the 34 most polluted rivers in the nation. Each river on that list was said to be so polluted as to require cleanup measures above and beyond the requirements of the Clean Water Act. Kingsport, Tennessee is on the Virginia border and the North Fork of the Holston River begins in Virginia. Fishing had been banned by the FDA in the North Fork since 1970, due to the extreme mercury pollution found in the fish.

The sources of the mercury were found to be discharges from Olin Corporation's chlorine and caustic soda plant in Saltville, Virginia and leaking waste water storage ponds from the same plant.

The Olin Corporation operated the plant from 1950 until 1972, when the plant was closed. The processes by which the chemical were produced used mercury as an electrode material. The mercury then became a pollutant in the waste water of the plant or a contaminant of storage ponds following the disposal of the electrodes when they were replaced. Although the Olin plant was closed in 1972, the storage ponds remain on the banks of the river. These man-made ponds cover an area of 120 acres and parallel the river for more than a mile.

As more and more areas of the country are identified as toxic waste sites requiring immediate and expensive attention, citizens are becoming frustrated and panicky about the upsurge of new exotic chemicals being produced (and dumped). In actual fact, however, the two possibly most dangerous materials in large supply throughout the country are neither new nor man-made and we have known for centuries that they are potentially harmful. The two are lead and mercury.

Mercury, or quicksilver, is the only metallic element which is liquid at room temperature. Before the Christian Era, it was known that mercury could be obtained from the cinnabar ore when it was heated. Mercury was also used to purify gold. It is important to note that it will react with gold jewelry and cause permanent damage to it. Originally, the large cinnabar mine in Spain was worked only by slaves. Later, convicts worked the mines, and still later, it was decreed that any man who worked in the mercury mines for two years had fulfilled his civic duty and was exempted from military service. This, as well as the precautions taken, leads us to believe that the dangers of mercury mining were known as early as 150 A.D.

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Mercury has many commercial and industrial uses. It has been used as a diuretic (calomel), as an antiseptic (mercuric chloride), in photography and in some paints. Mercury is used in dental alloys, thermometers, barometers, electrical switches and as electrode material. Mercury is a catalyst for various chemical processes and is also used in mercury boilers as a power generator. Iron is one of the few metals that will not amalgamate with mercury, therefore, the refining furnaces are usually lined with iron and mercury is shipped to many industries in iron flasks. We have no substitute for mercury which has unique applications as the only metal that is liquid at room temperature.

Mercury enters the environment most frequently as leakage from industrial processes, especially those which produce chlorine (which is used in the production of many plastics) or caustic soda. Mercury is often a water contaminant from pulp and paper mills. It is an ingredient in agricultural fungicides, used for treating seeds. Some amounts of mercury are found in all fossil fuels, and burning those fuels releases the metal into the air. Medicines flushed down the drain and broken thermometers also contribute to mercury contamination.

Mercury in the earth's crust is constantly being released into the atmosphere by mining operations (of any ore) and by simple tilling of the soil. Mercury is naturally occurring in seawater, but the effects of mercury contamination of water seem to be most severely found in fresh water lakes, streams and rivers. The reasons for this are complex. Metallic mercury is relatively non-toxic to humans, however, there are freshwater bacteria capable of ingesting metallic mercury and converting it to a much more toxic substance, methyl mercury. Methyl mercury is absorbed by plankton, which in turn, is consumed by fish. This poison is bioconcentrated and amplified by food chains in the aquatic ecosystem. Fish appear to absorb methyl mercury both from their food and through their gills. The mercury concentration in some fish can be 3,000 times the concentration in the water around them. Small fish are eaten by bigger fish and eventually, we find dangerously high levels of mercury in large fish such as the swordfish and the tuna.

Both swordfish and tuna fish have been recalled from commercial preparation in this country due to excessive contamination. Also recalled were some iron supplement pills sold in several health food stores. They were made from seal livers and were contaminated with 60 times the permitted level of mercury, when tested. Native Alaskans, who eat large quantities of both seal and fish, are found to have extremely high levels of mercury in their bodies. Apparently, individuals vary in their sensitivities to methyl mercury. A famous localized disaster occurred in Minamata City, Japan. A chemical plant greatly increased its production and release of mercury into the Minamata Bay. The population due to eating large quantities of local seafood, had over 100 people seriously affected either by damage to the nervous system or by death.

Mercury is recognized as an international pollutant. Ten percent of the amount ingested goes to the brain and kills cells. The symptoms of mercury poisoning are often mistaken for brain damage, encephalitis or senility. Mercury poisoning can result from ingesting solid mercury or from breathing mercury vapors. Symptoms may include loss of appetite, high blood pressure, trembling of lips, tongue and limbs, dermatitis, headache, insomnia, excitability, loss of coordination, blindness, deafness, madness or death. The term "mad as a hatter" was a result of the use of mercury nitrate in the manufacturing of felt hats.

Veteran workers in this industry frequently displayed symptoms of mercury poisoning.

Only the most limited tests have been completed to begin to find the effects of low levels of mercury on humans over time. If mercury is ingested with food, 100 parts per million (ppm) is fatal. In many areas of the U.S.A., warnings have been issued against eating game birds, aquatic mammals and fish. In 1970, mercury was found to reduce photosynthesis in phytoplankton, both marine and freshwater varieties. Photosynthesis was significantly inhibited at 0.1 ppb. At 50.0 ppb, all growth of phytoplankton stopped.

Perhaps, the most unusual factor in the mercury contamination story is the way in which we became aware of the increasing problem. Quite by accident, a Canadian graduate student first documented an abnormally large amount of mercury detected in a wall-eyed pike on which he was doing a routine autopsy. This was in March, 1970. The Canadian government made the first studies which led to the body of information, collected by several research groups, available today. Since that time, large amounts of mercury contamination have been discovered in the Niagara River in New York, in several waterways in Alabama and in the Holston River in Tennessee and Virginia.

Berry's Creek, within a mile of the Meadowlands Athletic Complex and Giant Stadium in New Jersey, was found to be the receptacle for 300 tons of mercury from a defunct chemical company. Ironically, Berry's Creek was so polluted from other sources that the oxygen necessary for bacteria to convert metallic mercury to methyl mercury was not available. The mercury was still waiting to become toxic when discovered.

The cleanup of such sites is difficult and very expensive. Currently, the Clean Water Act requires that industries discharging industrial wastes or by-products into bodies of water install the best available technology. They are required to clean these discharges to the point that they pose no health hazard. All industry must be in compliance by 1984, however, this law was not yet written in the 1930's, 1940's and 1950's, and those are the years when a substantial amount of mercury waste was deposited in several Virginia rivers.

The Olin Corporation plant operated on the banks of the North Fork of the Holston River from 1950 until 1972. E. I. DuPont operated a textile plant on the South River from 1929 until 1950. This plant, near Waynesboro, used a mercury compound, mercuric sulfate, to manufacture acetate fiber. Both industries have been closed for years, but the mercury is still in the rivers and is still slowly being changed into a more toxic substance by the action of aerobic bacteria.

In late September, 1982, the EPA-mandated cleanup of the North Fork of the Holston River began. The flow of the river was temporarily diverted from a 1,000 foot section near the Olin property. The exposed river bed was dotted with globs of mercury. This area was dredged and the dredgings were deposited on the old plant site. As of April, 1983, all that remained to be done was the reclamation of mercury from the dredging, the depositing and sealing of the cleaned sediment and five years of monitoring of the area to demonstrate the degree of success or failure.

Included in the cleanup plans were the filling of cracks in the underwater bedrock with cement and replacement of the dredged river bed with uncontaminated material. A separate operation for cleaning the water storage ponds was begun in

August, 1982, when a trench was dug around them to prevent further leakage. The cost of both programs was estimated to be three million dollars. Olin Corporation has agreed to pay this cost.

The same procedures will not be used to clean other Virginia rivers. The major differences in the two sites are that the Olin mercury plant gave off 56 grams of mercury per day, and the DuPont plant gave off 7 grams of mercury per day. The Olin mercury settled in a area of 1,000 feet, while the DuPont mercury settled in an area of over 90 miles of river bed, which means that both the South River and the South Fork of the Shenandoah River should be monitored. For five years, E. I. DuPont will pay $100,000 a year for this monitoring and for an independent study of the biota of the South River. Only time will reveal the answers to the questions raised by these problem areas in Virginia.

ACTIVITIES

Guest Speaker

A speaker from the State Water Control Board Office may be invited to present an update on recent changes in Virginia standards relating to mercury levels in streams and the progress of the monitoring and cleanup of the sites and rivers. The involvement of the Superfund and the State Bureau of Solid and Hazardous Waste could be investigated.

Bulletin Board & Library

Students may want to collect and make a bulletin board of news clippings relating to mercury pollution and standards. It may be of interest to have them include the many uses of mercury as part of a display. Library books on the Minamata Bay incident are available. A recent historical search on the mercury levels in seafood should be of interest.

A Demonstration/Group Laboratory Exercise Simulating the Chemical Reaction of Methyl Mercury Occurrence

Some of the principles covered in this teacher demonstration or small group activity include how a fairly non toxic form can be changed into a toxic form, how subtle changes within an ecosystem may result in non subtle consequences, how contamination may occur naturally or through man-made processes, and how man-made contamination is usually more drastic and more difficult for the ecosystem to assimilate.

Materials needed include a map of Virginia or the Eastern U.S.A. showing the rivers. A road map will suffice. A glass aquarium or other container to represent the river being contaminated is needed. Steel shot or balls at about 50-100 per test run, olive oil (10 ml), 1% Pancreatin solution, 5% Bile salts solution and pH paper are required for the simulation. The solutions are available from most biological supply companies and are inexpensive.

In order to demonstrate the chain of events leading to the production of methyl mercury in the biosphere, a teacher or team leader can set up a model for the river and the manufacturing plant. The teachers needs to become thoroughly familiar with the background information on mercury given in th previous part of this lesson. A map of Virginia or of the eastern U.S.A. will be helpful so that students can locate the actual sites of such contamination. Since the use of mercury and the appropriate bacteria in the classroom would be, of itself, hazardous and could possibly produce methyl mercury, we are suggesting a safer process to imitate the phenomenon visually. Care must be taken to use appropriate language, i.e., this represents the metallic mercury.

Preliminary preparation includes the setting up of a shallow "river" aquarium by putting a layer of coarse sand in the bottom of a glass container and covering it with a least 10 cm of water. Water plants may be included for a more realistic effect but we do not recommend floating plants. To coat the steel shot, immerse the 50-100 set in a shallow container of olive oil. Take the shot out and allow them to rest on several layers of paper towels. Excessive oil should be removed since you want only a very thin layer of olive oil on each shot. Olive oil is insoluble in water as is mercury, however, mercury sinks to the river bed and the olive oil will float on the surface , especially if there is excess on the shot.

Using the pH paper, test the pH of the "river". You want a neutral or slightly alkaline test since acid will indicate the presence of methyl mercury. Once you have established an alkaline river, explain the gradual introduction of the mercury-laden wastes into the river as you put the oil coated shot into the "river", one at a time. Test the pH of the "river" again. Explain to your students that the metallic mercury clearly visible on the bottom of the "river" is only slightly toxic and unlikely to dissolve.

Next, slowly add the bile salts solution to the "river". Explain that the solution represents oxygen dissolved into the water of the river. Wait for one minute. Slowly add the pancreatin solution to your "river". This solution represents the aerobic bacteria present in most rivers. These bacteria are able to metabolize the metallic mercury, converting it to methyl mercury. Methyl mercury is highly toxic. As you discuss this for 2-5 minutes, the pancreatin solution will digest the layer of olive oil from the shot. This metabolism will release fatty acids into the water.

Once again, using pH paper, test the water. An acid test indicates that methyl mercury is being produced. Call attention to the fact that the majority of the mercury remains on the river bottom. The conversion of metallic mercury to methyl mercury can continue over hundreds of years, unless the mercury is removed.

If you have not previously discussed the cleanup of the North Fork of the Holston River, solicit suggestions from the class for ways of stopping the problem in your "river" and in the Virginia rivers already polluted by metallic mercury.

Additional shot and enzymes may be added to experimental set ups for use with later class sections and/or groups.

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VOCABULARY

Hg, quicksilver, methyl mercury, enzymes, aerobic bacteria, electrode, FDA, EPA, bioconcentration, phytoplankton, Berry's Creek, Minamata, Saltville, North Fork of the Holston River, South Fork of the Shenandoah River.

ACKNOWLEDGMENTS

This edited version was originally developed and tested by Vickie O'Dell, a faculty member at Douglas Freeman High School in Richmond, VA.

ADDITIONAL NOTES

Legal Rights And Responsibilities

MAJOR PURPOSES

- *To develop an understanding of the American legal system and the rights and responsibilities of citizens within that system
- *To develop respect for and willingness to use and participate in our legal system
- *To develop awareness of a significant toxic substance -- asbestos

RELATED CONCEPTS/ UNDERSTANDINGS/ QUESTIONS/ AND SKILLS

- *To understand such basic legal principles as "rule of law" in seeking equity in our free society
- *To appreciate the importance of defining the issues under consideration from those that are not a part of the decision-making process
- *To appreciate and respect the rights of the parties involved
- *To become aware of possible benefits and limitations of legislation
- *To appreciate the importance of and potential difficulties in determining scientifically what is a hazardous level of exposure for an otherwise useful substance

INSTRUCTIONAL APPROACH

This project uses a mock trial based on a hypothetical civil suit against an asbestos manufacturer.

OVERVIEW

An exciting and popular exercise which allows for direct student participation in the teaching-learning process is the simulation. One of the most successfully used simulations is the mock trial. A key to this success is the choice of the case to be tried. The well-known substance, asbestos, provides a subject that is familiar and controversial. Using an asbestos related case for a mock trial allows students opportunities to develop insights into our court system and the role of legal rights and responsibilities in developing good citizenship. At the same time students are learning about aspects of the toxic substance crisis through one specific example.

The role of the citizen in the legal system as well as the functions of a trial court are subjects which have application in history and government classes as well as civics courses. Questions which can be pursued include: How is a defensible position in a controversial issue developed? What relationship exists between citizens and our legal system? How does the American legal system balance the rights of various parties involved? How are the benefits and liabilities of technology determined by society? Has that attitude changed?

An important concept in our legal system is the "rule of law". By this principle all citizens -- individuals as well as businesses -- are to be equal before the law and established legal procedures are to be followed in the application of the law. A mock trial provides an excellent opportunity to make this concept vivid to students.

In cases involving health problems that are long in manifesting themselves, such as those associated with asbestos, students will get a chance to see that the best knowledge about toxicity from one period is not necessarily the same for another period. This means it is important to weigh whether procedures were being followed that were based on the best available information at that time. How many experts knew about effects of asbestos in the past is still being debated. In any case, students will have a chance to appreciate the importance of this consideration in making equitable decisions in legal cases as well as in interpreting history.

REASONS FOR APPROACH

The technique of using a mock trial to break down complex issues is similar in many respects to using a case study. The learning is student-centered as they individually research their roles and the material for which they will be responsible -- thereby examining one part in detail which will lead to a better understanding of the whole. And, like case studies, the mock trial is open-ended; that is, there are no right or wrong answers as students develop their most defensible positions. Students are free is explore many possible conclusions and engage in values clarification as they consider alternatives. One of the most exciting results of using mock trial techniques is the active participation of students.

The subject, asbestos poisoning, was used because of its high interest potential for the students as well as its being a significant environmental problem. The subject of toxic substances has become one which touches the life of every American. The problem, however, is so vast that any attempt to study the general topic of hazardous substances is unmanageable. By taking one situation -- asbestos poisoning in this case -- the students will

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study one significant part of the problem. During the debriefing specific material that is identified can be used to construct some hypotheses about the larger problem of toxic substances. Some examples of debriefing material will be presented later in this unit.

INTRODUCTION TO ACTIVITIES

This unit includes a detailed set of instructions for a week-long mock trial. The individual roles and responsibilities can be expanded or simplified depending on the number of students participating and their level of academic sophistication. Experience has shown that much of the day-to-day activity will be spontaneous (an excellent teaching method if used properly) and will maintain a high level of student participation.

The role of the teacher in a mock trial can take one of two forms: trial judge or impartial observer. If the teacher chooses to be an observer, a person to serve as judge should be brought from outside the class -- perhaps a trial lawyer, law school student, or a lay person familiar with court procedures. (The local young lawyers group of the local American Bar Association should be helpful in finding a resource person.) Because the judge rules on motions and maintains order, it is a role difficult for a student to assume with his classmates.

Five consecutive class periods should be set aside for the mock trial as follows:

Day 1 - introduction of activity and assignment of roles
Day 2 - individual research of roles and responsibilities in preparing case (this may include library research and should be arranged in advance with the librarian)
Day 3 & 4 - actual trial activities
Day 5 - announcement of verdict and debriefing activities

DAY 1:

Give students the general information (See Project Appendix for the General Information section) about the case of John Doe versus Morris Manufacturing. Discuss terms such as plaintiff, defendant, alleges, etc. to be certain students have a clear understanding if this has not already been done. Students should already have some information about asbestos but time should be taken to clear up any misconceptions and/or provide information where necessary. (See Project Appendix for information about asbestos)

Allow students opportunity to read and ask questions before assigning roles. (Some teachers may wish to allow students to choose their roles but there are liabilities. Many students will want the roles they perceive to be glamorous -- attorney or judge. This could lead to resentment by these students when given other roles. Also some students may be less capable of playing certain roles and the benefits of the simulation could be minimized for them.) Experience has shown that students function best when assigned roles by the teacher.

DAY 2:

Each set of attorneys and witnesses will need to work closely within the team (but separate from the other team) to research material and prepare their cases. Individuals will be responsible for outlining questions (direct and cross-examination) and sketching brief responses based on the information they have. While these participants are working, jury members should be kept away so that they will later function within their prescribed roles. Jury members could be assigned research questions based on the Juror's Handbook (available from local courts). Each student should have a copy of the information about their individual role and the outline of suggested remarks (See project's appendix).

DAY 3 and 4:

Using the diagram of a courtroom (See Project Appendix) provide a setting in the classroom which duplicates as closely as possible an actual courtroom. As students enter on "day 3", have them take their assigned roles immediately and begin the trial with the Narrator. Follow the trial procedure and schedule as closely as possible depending on your time limitations. Each day's activities should fit within a 50-minute class period.

DAY 5:

The jury submits its verdict which is read to the class. Observer/reporters then submit their evaluations, and opportunities are presented for them to discuss the evaluation. The judge should also be encouraged to share his reflections about the mock trial proceedings (this is especially helpful if a trial lawyer has served as judge).

The remainder of the class (about 40-45 minutes) should be used for the debriefing period. Usually the most significant learning experience in a simulation is the debriefing period. The EIAG debriefing model, explained in detail in this book's project "MAKING DECISIONS -- A SIMULATION", has proven to be the most effective model used. Questions to be discussed could include: How did participants feel about their individual performance? Was evidence introduced properly? How did the jury feel about the plaintiff? The defendant? Was the verdict fair? Based on what considerations? What influenced the jury most? What does the verdict say about our attitude toward toxic substances? Is this the attitude of the larger society? What can individual citizens do to prevent further damage by toxic substances?

SEE FOLLOWING PAGES FOR THIS PROJECT'S APPENDICES I - IV

NOTES

PROJECT APPENDIX I

GENERAL INFORMATION

The Motion for Judgement in this case, filed by John Doe, Plaintiff, versus Morris Manufacturing Company, Defendant, alleges that the plaintiff contracted the lung disease asbestosis (See material on asbestos for information on this condition.) as a result of the following:

a. plaintiff was not warned of potential dangers from the defendant's product

b. plaintiff was not given adequate safety equipment

c. plaintiff was not given adequate instruction on safe handling of hazardous materials

d. plaintiff was exposed to potentially hazardous materials without testing the material adequately.

As a result of contracting the disease asbestosis, the plaintiff has been severely and permanently damaged and disabled; he has in the past and will in the future suffer a loss of earnings and incur hospital and medical expenses; he will ultimately die as a result of asbestosis.

Plaintiff therefore demands judgement against tbe defendant in the sum of one million dollars ($1,000,000.00) for damages.

GROUNDS FOR THE DEFENSE

The defendant, Morris Manufacturing Company, submits the following as its defense motion:

a. defendant denies being indebted to plaintiff in any sum

b. plaintiff assumed all risks by accepting and continuing to hold employment

c. plaintiff was negligent, misusing defendant's products

d. defendant's conduct was in conformity with state law regarding manufacture, sale, and use of product during the period involved.

ROLES

The success of a mock trial depends on the thorough preparation of EVERY participant! Experience has shown that using the mock trial approach is generally a way to insure active student participation.

Bailiff:

Maintain order and call the court to session.

Clerk:

Call the court to session, swear in witnesses, assist judge as required, receive the verdict of the jury.

Prosecution Attorney:

The defense will make the second Opening Statement and Closing Statement to the jury. The defense attorney will be responsible for direct questioning of the two defense witnesses as well as cross examining the two prosecution witnesses.

Dr. Deaver:

As plaintiff's medical witness, Dr. Deaver will be responsible for presenting that evidence which will enhance the plaintiff's allegation that asbestos was the cause and the only cause of the plaintiff's medical condition. This witness will be expected to have good knowledge of asbestosis and how the disease is contracted.

Mr. Doe:

Plaintiff will take the stand in presenting his condition as caused by employment with the Morris Manufacturing Co. He will need to be knowledgeable about his employment record as well as the disease asbestosis.

Dr. Pruett:

As the defense witness responsible for refuting the plaintiff's case, Dr. Pruett will need to have knowledge of the disease asbestosis as well as other lung disorders and their causes. He should be careful to point out the number of causes possible for these diseases.

Mr. Burke:

As a co-worker of Mr. Doe, who does not have asbestosis, Mr. Burke will testify as to working conditions, safety precautions, etc. in the plant during the time of Mr. Doe's employment.

Members of the Jury:

As jury members students are responsible for listening carecarefully to all testimony. The verdict must be based on testimony given during the trial only.

Observers/Reporters:

An optional role. Observers follow all trial proceedings and complete an analysis sheet. (See Project Appendix III).

Narrator:

Also an optional role, which can be assumed by the bailiff or clerk. The narrator sets the stage for the trial (See the "ENACTMENT" section that follows)

ENACTMENT

Narrator:

Imagine yourself in a high-ceiling walnut-paneled federal courtroom. There the jury is impaneled in a jury box, and the judge sits at a high bench and controls the litigation of the case, responds to arguments made by attorneys, and instructs the jury on the issues it decides.

On this day Mr. John Doe has come to file a petition seeking substantial sums of money from the Morris Manufacturing Co. Mr. Doe alleges that the Morris Mfg. Company, a manufacturer of asbestos products, is responsible for his present state of ill health.

Asbestos was used as a material for approximately 40-50 years to insulate pipes and was an excellent fire retardant. It was banned, however, in the late 1960's and early 1970's because it was found to cause disease among those workmen using it.

Mr. Doe, in his motion now before the court, claims that he is unable to work because he has contracted the disease asbestosis as a direct result of his employment with the Morris Manufacturing Company.

Opening of the Court:

Clerk - "All rise. The First Federal District Court is now open and in session, the Honorable Judge ____________________ presiding.

The court will come to order. The case before the bench is John Doe versus Morris Manufacturing Co. Are the attorneys present and ready?"

Judge:

(Instructions to the jury) "The jury is to remain silent during the trial. It is your duty to listen attentively so that you may make a responsible decision when called upon to do so. Your decision will be based solely on the testimony given here and on the evidence presented."

(FOR OBJECTIVES AND SUGGESTIONS CONCERNING OPENING AND CLOSING STATEMENTS AND CROSS EXAMINATION, PLEASE REFER TO THE NEXT SECTION IN THIS APPENDIX)

Plaintiff's Attorney's Opening Remarks: (5 minutes)

"Ladies and Gentlemen of the jury, my client, John Doe, is unable to work now because he has a disease called asbestosis. Mr. Doe worked for the Morris Mfg. Company for thirty years as a pipefitter. My client's job was to cut and mold the asbestos product and when he sawed or cut it, small particles of asbestos would fly into the air where they were inhaled. He had not been provided with protective masks to prevent his breathing in those asbestos particles. Recently my client was forced to quit his job on the advice of his physician. Dr. Deaver will be a witness today and will testify that 30 years of inhaling asbestos particles has caused my client to suffer from the disease asbestosis."

Defense Attorney's Opening Remarks: (5 minutes)

"Ladies and Gentlemen of the jury, my client, the Morris Manufacturing Company is innocent of any wrongdoing in this case. I present to you that John Doe's problem in breathing is not necessarily due to the asbestos products but because of many substances that he may have come in contact with over the years. His breathing difficulty may also be the result of his heavy smoking and not due to his exposure to the asbestos products. He could also have bronchitis and other forms of chronic lung disease not necessarily resulting from exposure to asbestos.

You, the jury, must decide whether the prosecution has proved beyond a shadow of a doubt that it is asbestos and nothing else which has caused Mr. Doe's breathing problems.

The defense will present witnesses who will refute any charges that Morris Manufacturing is in any way responsible for Mr. Doe's present condition.

Thank you."

First Witness for the Prosecution, Dr. Deaver: (Maximum 16 minutes)

Questions by the prosecution attorney are followed, using the proper questioning techniques, by cross-examination from the defense attorney.

Second Witness, Mr. Doe: (Maximum 16 minutes) Proceed as with the first witness.

START OF DAY THREE

First Witness for the Defense, Dr. Pruett: (Maximum 16 minutes)

Attorneys reverse the style of questioning so that the defense attorney is now asking direct (rather than cross examining) questions, etc. Following the defense attorney's questions the prosecuting attorney should cross-examine the witness.

Second Witness for the Defense, Mr. Burke, Co-worker:

(Maximum 16 minutes) Proceed as with the first witness.

Prosecution, Closing Arguments and Defense Closing Arguments:

(Maximum 5 minutes each)

Briefly restate opening remarks and show how you have developed your case. Remember to ask the jury for the exact verdict you wish them to return and thank them for their attention.

NOTES

PROJECT APPENDIX II

OBJECTIVES AND SUGGESTIONS FOR STATEMENTS AND EXAMINATIONS

OPENING STATEMENTS:

Objective: To acquaint the judge with the case, and outline what you are going to prove through witness testimony and the admission of evidence.

What to Include: (a) a short summary of the facts, (b) mention of the burden of proof and who has it in this case, (c) the applicable law, (d) a clear and concise overview of the witnesses and physical evidence you will present and how each will contribute to proving your case, (e) an introduction of your colleagues.

DIRECT EXAMINATION:

Objective: To obtain information from favorable witnesses you call in order to prove the facts of your case.

What to Include: (a) isolate exactly what information each witness can contribute to proving your case and prepare a series of questions designed to obtain that information, (b) be sure all items you need to prove your case will be presented through your witnesses, (c) ask direct questions -- ones designed to let the witnesses tell the story, describe what happened, etc.

CROSS EXAMINATION:

Objective: To make the other side's witnesses less believable in the eyes of the court.

What to Include: (a) ask leading questions -- ones that can only be answered by a "yes" or "no". These questions are designed to suggest an answer to the witness and to get the answer the lawyer wants, (b) ask questions that establish that the witness is lying on important points, (c) ask questions that show the witness is prejudiced or biased against the defendant, etc., (d) ask questions that weaken the testimony of the witness by showing his opinion is questionable because of poor lighting, etc., (e) ask questions that show that an expert witness or even a lay witness who has testified to an opinion is not competent or qualified due to lack of training or experience.

CLOSING STATEMENT:

Objective: To provide a clear and persuasive summary of the evidence you presented to prove your case and the weaknesses of the other side's case.

PROJECT APPENDIX III

MOCK TRIAL ANALYSIS SHEET

On a scale of 1 to 5, with five being the high figure, please rate the students in the following areas:

("P" COLUMN APPLIES TO THE PROSECUTION; "D" COLUMN APPLIES TO THE DEFENSE)

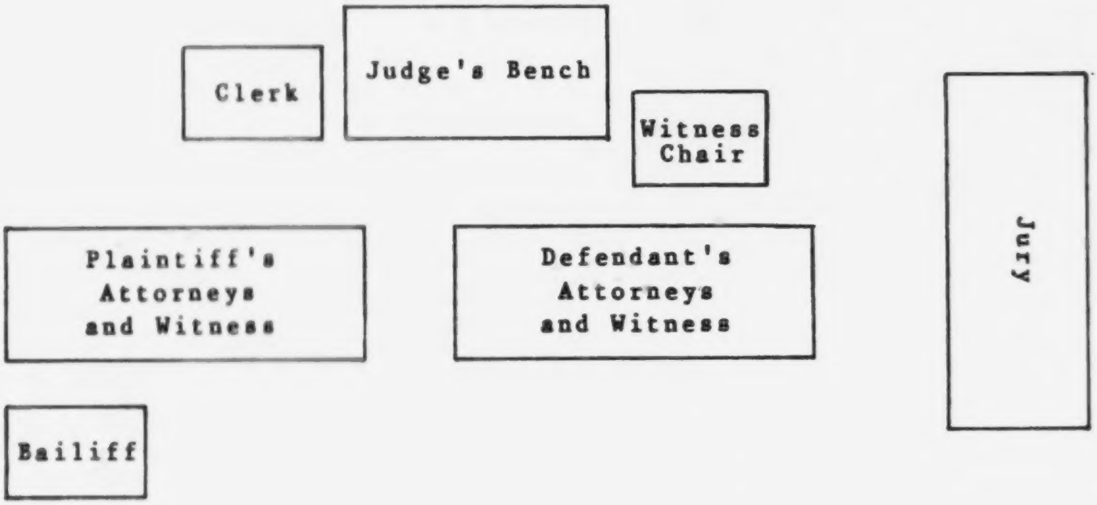
P	D	
		1. Attorney gave a clear and concise presentation of the case in the opening statement.
		2. Attorneys' questions and direct/cross-examination: a. were clearly stated; b. were concise and to the point; c. resulted in straightforward answers from the witnesses; d. brought out information important to the case; e. on the cross-examination, brought out contradictions in testimony.
		3. Attorneys made timely objections;
		4. Attorneys a. were responsive to questioning from the bench; b. were responsive to unexpected answers from witnesses.
		5. Attorneys were courteous and observed courtroom decorum.
		6. Attorneys observed courtroom procedure pertaining to introducing evidence and impeaching witnesses.
		7. Attorneys exhibited a clear understanding of the issues and law appropriate to the case.
		8. Attorneys made an organized and well-reasoned closing argument.
		9. Witnesses were well-prepared and responsive in answering questions posed to them.
		10. Witnesses were believable in their characterizations and convincing in their testimony.
		11. Witnesses brought out the most important points for their particular side.

What to Include: (a) a thank you to the judge for time and attention, (b) isolate the issues and describe briefly how your presentation resolved these issues, (c) review the witness testimony; outline the strength of your side's witnesses and also the weaknesses of the other side's witnesses, (d) review the physical evidence, if any, (e) state the applicable statutes and any cases to show it supports your side, (f) remind the judge of the required burden of proof; if you are the plaintiff's lawyer you must tell and convince the court that you have met the burden; if you are the defense lawyer you must inform the court and convince the court that the other side has not met the burden of proof, (g) argue your case by stating how the law applies to the facts as you have proven them, (h) don't forget to request the verdict you desire.

ADVICE FOR LAWYERS: Learn your case thoroughly. Don't be cocky and think that just because you talk a lot you will do a good job. Write your questions out before you ask them but don't read your questions in court. Practice with your witnesses to be sure you know your questions and they know their answers. LISTEN to the witnesses in court to be sure they said what you think they said. Be ready to adapt your questions during court.

ADVICE FOR WITNESSES: Know your testimony thoroughly and answer in CLEAR and CONCISE words. Be sure the judge can hear you!

COURTROOM ARRANGEMENT


Clerk
Judge's Bench
Witness Chair
Jury
Plaintiff's Attorneys and Witness
Defendant's Attorneys and Witness
Bailiff

PROJECT APPENDIX IV

BACKGROUND INFORMATION ABOUT ASBESTOS

Asbestos is a family of fibrous particles that, when free floating, and inhaled, lodge in the lungs and remain there for long periods of time. Asbestos is largely used in the building and construction industry for strengthening cement, plastics, for heat insulation and sound absorption.

Workers heavily exposed to asbestos have a high risk of several serious diseases including asbestosis and lung cancer. Asbestosis is a chronic lung disease whose most prominent sympton is shortness of breath on exertion. Lung cancer is a malignant tumor within the lung itself. Its symptoms include a cough or change in the cough habit, chest pain and occasionally, blood streaked sputum coughed up from the lungs.

The Department of Health, Education, and Welfare estimates that since the early 1940's, as many as eleven million workers have been exposed to concentrations of asbestos dust in harmful quantities. Included in these eleven million employees are four and a half million shipyard workers. Employment in the shipyards reached its peak during the war years of World War II. According to the H.E.W study of those workers, approximately four million are believed to have had heavy exposure to asbestos and the total fraction of heavily exposed workers likely to die of cancer is probably between 25% and 44%.

Recently the National Cancer Institute has undertaken a public awareness campaign to warn the public and physicians about asbestos exposure. The effort can be expected to generate a large number of Workers' Compensation and Product Liability claims for asbestosis and related diseases.

The only firm scientific data available at the present time deals with the people who have been heavily exposed, such as asbestos miners, people in asbestos manufacturing, and insulation workers. However, those who work directly with asbestos are not the only ones with increased risk of asbestos-related diseases.

Workers from a variety of trades who have been employed in shipyards and construction sites presumably in or near areas contaminated by asbestos dust, are now beginning to show signs of x-ray abnormalities in the lungs typical of asbestos exposure. Included in this group are: painters, electricians, carpenters, machinists, boiler makers, maintenance workers and others, who may not realize they were exposed. For these reasons, and because the serious diseases associated with asbestos take a long time to develop --

from 15 to 35 years or more -- the Department of Health, Education, and Welfare has undertaken a program to inform doctors, workers and others about the increased health risks of asbestos exposure.

Risks of disease to other occupational groups due to asbestos exposure has not been defined clearly as yet. Many exposed workers, however, may never develop asbestos related diseases. Others will, and there is no way to predict just exactly who they will be.

In the case of asbestosis and lung cancer, the risk increases in proportion to the intensity and duration of exposure. Also, scientists have found that asbestos workers who smoke have a risk of lung cancer eight times the risk of smokers who do not work with asbestos. Smoking and asbestos exposure interact positively. Together, they produce a risk of lung cancer that far exceeds the sum of their separate risk. There is some information that suggests that quitting smoking can reduce this extremely high risk in asbestos workers.

ACKNOWLEDGMENTS

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NOTES

Pesticides: Blessing Or Curse? Including A Home Survey And Label Study

MAJOR PURPOSES

*To introduce the effects of pesticides on target and non-target species
*To realize the safety factors required when handling pesticides
*To survey the home environment for pesticide containers and use
*To become familiar with product labeling

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS QUESTIONS

*To provide background information relative to pesticides
*To evaluate their occurrence in the home
*To identify the basic information on pesticide labels
*To demonstrate toxicity on plants and seeds
*To become familiar with "forced evolution" and bioconcentration
*To be aware of the potential hazard associated with pesticides

INSTRUCTIONAL APPROACH

This lesson is suitable for Life Science, Middle School Biology and Earth Science classes. It can be readily modified for other middle and high school classes. Some of the background material will have to be presented to the students but they may be required to read and report upon periodical articles from the library. The materials from the home surveys can be summarized by each class on posters for a bulletin board project and the students will have to collect data, graph it and summarized the response of plants and seeds to salt. We have purposely avoided the use of any insecticide or pesticide as part of an experiment.

It is suggested that the teacher caution the students about transporting empty containers to school. The teacher may want to personally collect samples of container labels not only from pesticides but also from other toxic materials often found about the home such as those found in the garage or related to a hobby. Photocopies or slides of these would be very effective teaching tools that could serve for future use.

OVERVIEW/BACKGROUND

Pesticides literally affect every aspect of our daily lives, from the wood used in the house, the food we eat to the home itself and the lawns that surround the home. It can be effectively argued that pesticides have helped to raise our standard of living by providing increased production of food and timber.

This high standard of living has had it's hidden price. Rachel Carson's Silent Spring explained the cost in terms of pesticides' effects on non-target species, including man. Pesticides do help control their target species, but they also affect other species and pass up the food-chain by bioconcentration. Since the publication of her book in 1962, a vigorous debate has ensued based on the risks versus the benefits of pesticides - a debate predominately between agribusiness on the one hand and the environmentalists on the other. Each aspect of study used in this lesson will benefit by a risk/benefit analysis. The pro and con aspects should be presented for all instances.

A pesticide can be defined as any chemical used for killing insects, weeds..... This can also include animals such as rats, coyotes... This broad definition includes insecticides and herbicides (weeds). These groups can be further divided into natural (those obtained from natural sources) and man-made (synthetic) organic compounds.

Natural pesticides were used prior to the 1940's. They were derived mainly from plants (nicotine, for example) and they broke down quite easily in the environment. Man-made organic compounds were produced on a massive scale after World War II. They are generally cyclic hydrocarbon compounds initially derived from petroleum chemistry. The most widely known (and used today, though not in the USA) is dichlorodiphenyltrichloroethane - DDT. Many more have been produced and used widely including Clordane. These chemicals are generally long-lived in the environment. They are decomposed slowly.

A pesticide is used, as its definition implies, to control "pests". These pests include all types of insects (flying, crawling, burrowing), weeds, animals (rats, mice, coyotes), and fungi. They act by various means, killing by direct or indirect action on the target species. They can act through the skin/membrane, ingestion (poisoning), roots.... Pesticides are usually sprayed on the fields by tractor-pulled sprayers, through irrigation systems or by dusting from an aircraft.

The application of pesticides has increased drastically since World War II with the conversion of agribusiness to large scale farms based on a few crops as opposed to the predecessor family farm having small scale farming and various crops. There was more food in one place and the pest population increased (proportionately). Thus the problem required increased use of controls such as cheap man-made pesticides. This has added massive quantities of "un-natural" chemicals to the environment (land, surface water, ground water and air).

Problems have followed this increase in the use of pesticides. Insects multiply rapidly and some species may have multiple generations in a summer. The vast numbers also guarantee a large amount of genetic variety. Thus, when fields are sprayed, many of the target species die, but some are genetically able to handle the pesticide. These few survive and breed, eventually to cause a problem again. This problem is usually handled the same way as before, by application of chemicals. The previous dosage no longer does an effective job because the target species has been "un-naturally selected". They are more resistant. This leads to an increase in dosage or the use of another pesticide and the cycle starts over again. This is an example of "forced evolution".

Pesticides tend not to be single species specific, so other insects/plants are

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killed also. This may allow a species formerly kept in check by natural predators to suddenly multiply and become a pest itself. Then new pesticides or dosages are needed to control the new pest.

Pesticides affect other species of plants and animals by several mechanisms. The pesticide can pass into the food chain by direct ingestion of "infested" insects or plants, or by absorption from ground water or runoff in streams, ponds, rivers...Because pesticides are not easily metabolized, they tend to accumulate in the tissues (bioconcentration or bioaccumulation). The effects of this can be quick, such as the poisoning of buzzards when they eat a coyote that has been controlled with compound 1080 (Sodium monofluoroacetate) or long-term, such as the decrease of bird populations due to the effects of DDT on eggs, causing them to be brittle and break before proper incubation. Sometimes, fewer eggs are laid. Also, pesticides can also affect humans. These are toxicants that can cause immediate chemical poisoning reactions when taken in large doses. Their long-term bioconcentration effects are not as well known and are currently being studied.

ACTIVITIES

Activity # 1

Pesticide Use Around The Home

This activity can show students how they might come in contact with pesticides in the home. It should increase their awareness of the potential problem. A survey should be made using the format suggested in the following table. The survey is a tool to help students understand how to handle pesticides safely. A cover letter like the sample appended to this lesson should be sent home explaining the purpose of the survey and asking the parents to help the students with their project. After the surveys are completed, the results can be tabulated on the black board or bulletin board under general categories such a bug spray for indoors, flea powder, rose mite dust.... Also have the class discuss general safety rules and handling. Have the students list these on poster board. Suggest that these could be posted at home for ready reference. Include the number of the local Poison Control Center. This "Safe Handling" poster could also include the names of pesticides that the students listed on their survey for their homes. Please note that we are not asking or encouraging student use or handling of pesticides in this lesson.

HOME PESTICIDE SURVEY

NAME: ____________________

ADDRESS: ____________________

DATE: ____________________

NAME OF PESTICIDE	LISTED CONTENTS (ACTIVE AGENTS)	LISTED SAFETY PRECAUTIONS	TYPE OF PACKAGING	LOCATION IN THE HOME

Pesticide And Other Labels

Because many students come into contact with pesticides and will probably use them later in life, it is important that they know how to read completely the label on a pesticide container. To assure that students can read and understand such labels, the following activity is recommended.

Collect various containers for classroom use that are empty and clean. If students bring in empty containers be sure they are transported and handled safely. It is recommended that the teacher develop a set of slides or transparencies made from photocopies of these labels for a teaching aid. A variety of labels from drain openers to paint products may be used. Enclosed herein is a label (Figure 1) and questions from the Metro Toxicant Program as developed in Seattle. Use it as an example and then develop a similar worksheet using labels that are available to you.

Figure 1. Metro Toxicant Program Label For "Whiz Clean".

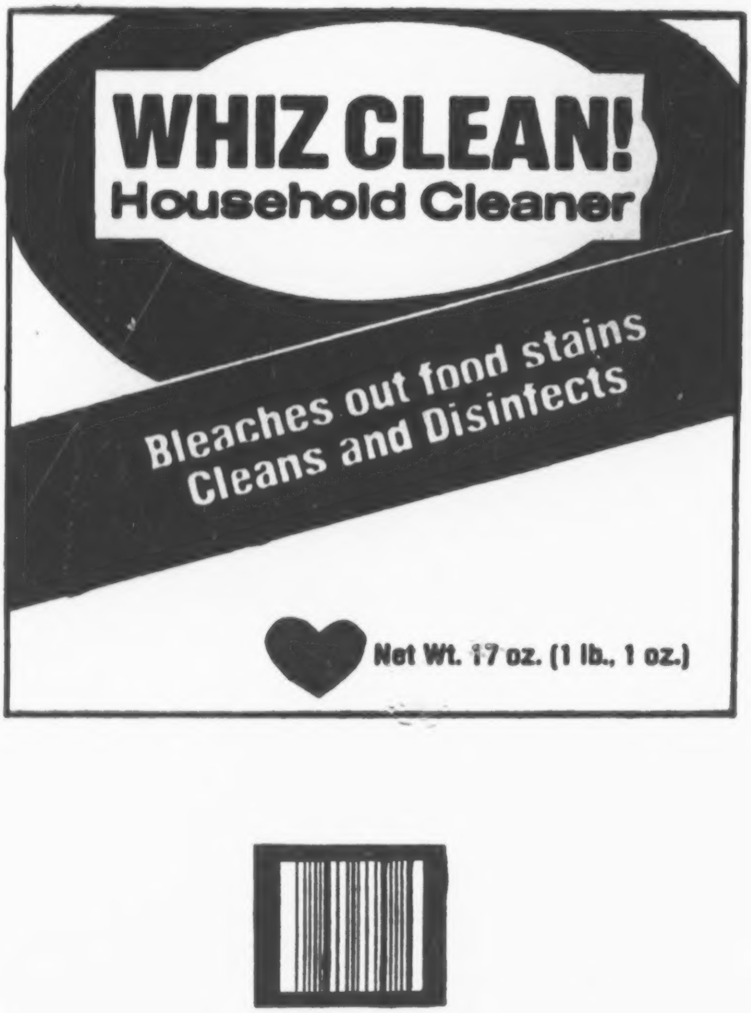


Figure 1. Metro Toxicant Program Label Written Details For "Whiz Clean".

USE WHIZ CLEAN ANYWHERE IN YOUR HOME

Bleaches Out Food Stains - Cleans and Disinfects

KITCHENS

Sinks: Whiz Clean cleans and whitens porcelain. Cleans stainless steel to a sparkle.

Countertops, Plastic Surfaces: Whiz Clean bleaches through food, beverage, ink stains. Wet sprinkle Whiz Clean, let soak for a while, then rub only as needed, rinse. Do not soak for prolonged periods.

Pots & Pans, Stoves, Ceramic Cookware: Whiz Clean cuts grease, scours off cooked-on food.

BATHROOMS

Sinks, Tubs, and Showers: Whiz Clean disinfects as it cleans.

Ceramic Tile, Fixtures: Whiz Clean cleans to a sparkle.

Toilet Bowls: Whiz Clean cleans and sanitizes. Sprinkle Whiz Clean liberally into bowl, scour and flush.

Vanity Tops, Plastic Fixtures: Special care should be taken in cleaning these surfaces. Let Whiz Clean work a minute or so with plenty of water. Rub gently if needed and rinse.

FOR TOUGH JOBS: For easiest results, let Whiz Clean work with water a minute or so, then rub as needed and rinse.

Other Uses: Whiz Clean cleans away soil and stains on cement floors, garbage cans, auto chrome, whitewall tires, out-door grills.

ACTIVE INGREDIENTS:	Trisodium Phosphate	13.50%
	Sodium Sesqui Carbonate	1.90%
	Potassium hypochlorite	0.45%
INERT INGREDIENTS:		85.15%

Includes Sodium tripolyphosphate, color, perfume, quality control agents. Whiz Clean averages 31% phosphorus in the form of phosphates.

QUESTIONS ABOUT THE "CLEAN WHIZ" LABEL

What is the brand name of the above product?

What is the product used for?

How does this product work?

List the ingredients and indicate which are the active ones.

How should this product be applied or used? (What are the directions?)

What precautions should be taken?

Add the % of each ingredient to the above list.

If you had 17 ounces of this product, how many ounces of active ingredients would you have?

How much actual product is used per each application?

If you use 3/4 ounce for each application, how long would it be until all of the container were used?

How much area would 3/4 ounce clean?

Are there any effects to human health or the environment which would result from use of this product?

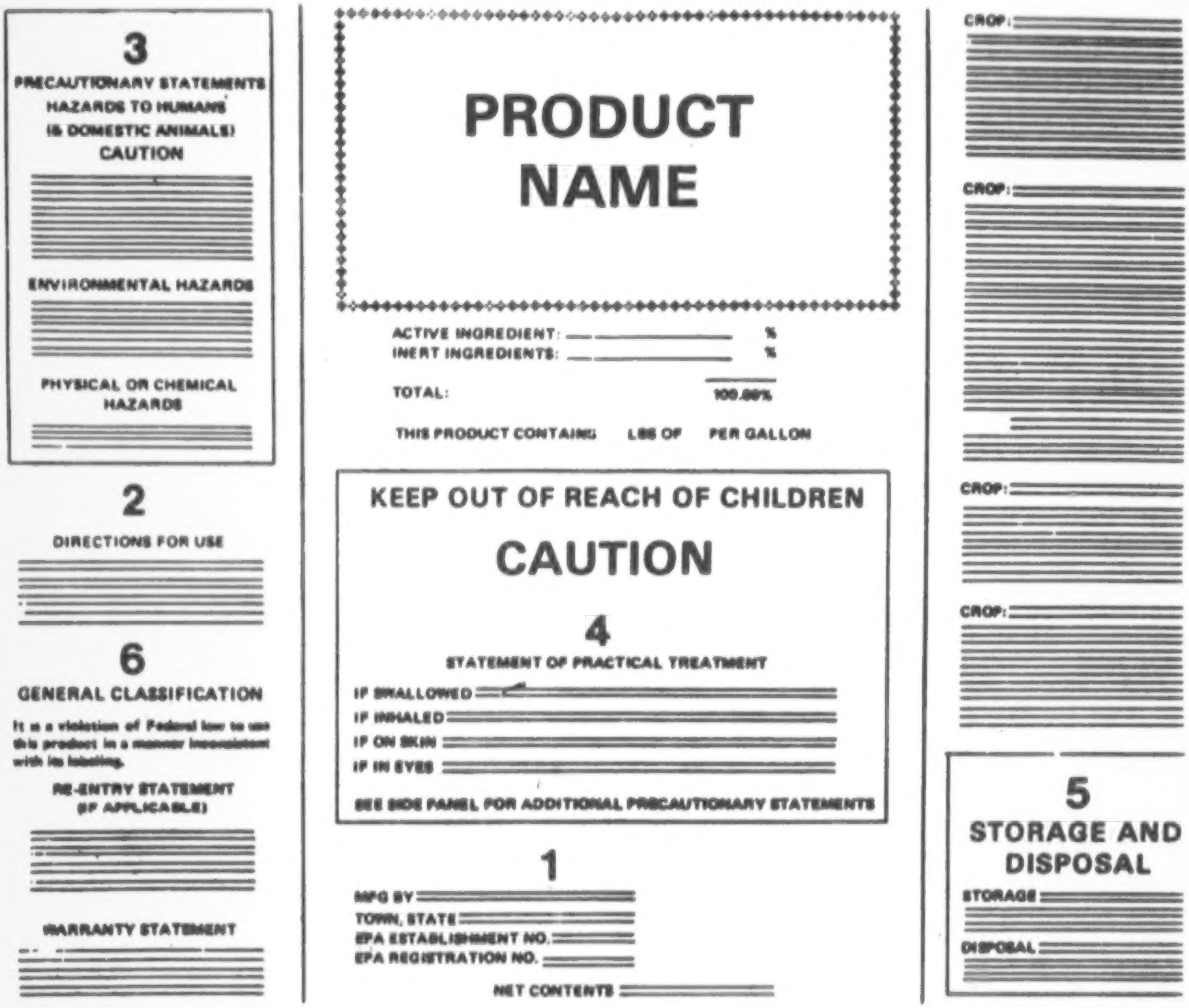
What suggestions, if any, are given for disposal of the container?

Do you know of any alternatives to use instead of this product?

Using the following Figure 2 from the EPA, which shows how to read a pesticide label, guide your students through several of the labels that you have on hand. Have various students in the class read one or more parts of labels. Be sure to point out to student the six main parts of the pesticide label. They are: EPA registration number; directions for use; precautions; first aid instructions, storage and disposal; and classification statement. These are explained in detail in Table 2 below. Discuss the importance and application of each part to the total pesticide poison prevention program, which such standardized labeling seeks to promote.

After all labels have been scrutinized and discussed, use the attached portion of a US Government Printing Office publication, "Pesticides Are Poisons - Read The Label", to emphasize the ideas for protecting the user and the environment by reading, heeding and following all instruction for properly handling a pesticide or other chemical agent.

Figure 2. How To Read A Pesticide Label.


3
PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS
(& DOMESTIC ANIMALS)
CAUTION
ENVIRONMENTAL HAZARDS
PHYSICAL OR CHEMICAL HAZARDS
2
DIRECTIONS FOR USE
6
GENERAL CLASSIFICATION
It is a violation of Federal law to use this product in a manner inconsistent with its labeling.
RE-ENTRY STATEMENT (IF APPLICABLE)
WARRANTY STATEMENT
PRODUCT NAME
ACTIVE INGREDIENT: %
INERT INGREDIENTS: %
TOTAL: 100.00%
THIS PRODUCT CONTAINS LBS OF PER GALLON
KEEP OUT OF REACH OF CHILDREN
CAUTION
4
STATEMENT OF PRACTICAL TREATMENT
IF SWALLOWED
IF INHALED
IF ON SKIN
IF IN EYES
SEE SIDE PANEL FOR ADDITIONAL PRECAUTIONARY STATEMENTS
1
MFG BY
TOWN, STATE
EPA ESTABLISHMENT NO.
EPA REGISTRATION NO.
NET CONTENTS
CROP:
CROP:
CROP:
CROP:
5
STORAGE AND DISPOSAL
STORAGE
DISPOSAL

BEST COPY AVAILABLE

Table 2. Details Describing The Six Major Parts Of A Pesticide Label As Written By The EPA.

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1. EPA Registration Number

Look for this number on every product you buy. The number is your assurance that the product has been reviewed by the EPA and should be safe and effective when used as directed on the label. Older products may have a United States Department of Agriculture Registration Number.

2. Directions For Use

Before you buy any pesticide make sure the product is labeled for use against the pest(s) you are trying to control. Read all label directions thoroughly before you open the container. Use only the amounts recommended, at the time and under the conditions specified, and for the purpose listed. (Don't think that twice the dosage will do twice the job. It won't. You may harm yourself or whatever you are trying to protect. It is also a violation of Federal law.)

3. Precautions

Read the precautions carefully. The most toxic products will be labeled "DANGER-POISON." The word "WARNING" on the label means the product is less toxic, but extreme care must be exercised in its use. The work "CAUTION" will appear on those products which are least harmful when used as directed. Pay particular attention to warnings about keeping children and pets out of treated areas and about special clothing that should be worn when using certain chemicals.

4. First Aid Instructions

Know what to do if someone is accidentally poisoned by a pesticide. Check the label for "Statement of Practical Treatment." This information will give instructions for immediate action. Then, ALWAYS call or get to a doctor or hospital right away. Be sure to take the pesticide label with you. Write the name of your doctor or local poison control center here and keep it handy.

________________________ Number of Local Poison Control Center

5. Storage and Disposal

Read and follow all directions for storage and disposal of pesticide products carefully. Keep all pesticides out of the reach of children, preferably under lock and key.

6. Classification Statement

After October 21, 1977, all pesticide products will be classified for either "general" or "restricted" use. Restricted use pesticides are highly toxic or require special knowledge or equipment for application and, therefore, will generally not be available for sale to the homeowner. Look for the statement "General Classification" on the label at the beginning of the directions for use to ensure that the pesticide is classified for use by the general public. Remember: By reading and following all label directions and warnings before you buy or use any pesticide, you protect yourself, your family and the environment from serious accidents.

Activity # 2

Toxicity Testing

Pesticides are considered toxic or poisonous to their target species. What is a toxic effect? This activity will show the toxic effect of common table salt (NaCl) on plants such as beans.

Effect of table salt on seedlings

Have the class germinate and grow five lima bean plants to about 3-8 inches in height. Have various concentrations of salt in distilled (or tap) water prepared and labeled for daily application of 10 ml. Salt water by weight could be 0, 1, 3, 5, and 10%. Make sure that the 0% is understood as a control for comparisons. Combine the data from the study for the class as a whole. Have the students water these plants using the same solution daily. Have them record their plants' heights daily and note any leaf changes such as color and size. Ask them to comment on the toxic responses noted. Have them plot their data in graph form and also develop a set of average data for the whole class to plot.

Effect of table salt on germination

Some pesticides act on the seeds of a plant so that germination is altered and/or stopped. Have each student germinate five lima bean seeds in a covered Petri or other dish. Use a clear dish with a paper towel so that the above salt solutions can be added to the paper towel. Have them note the number of days to germination initiation and other observations relating to shoot growth, root growth and color change. Other smaller and more sensitive seeds may be substituted as available.

Activity # 3

Survival Of The Fittest

This class activity could be explained as a game of chance. When pesticides are used, some insects are able to survive by having genetic "immunity", which is then passed on to their offspring.

Have students stand at the front of a class as insects. Inform them that they will receive 10 mg of pesticide per kg of body weight. Let them draw cards out of a paper bag. All but five of the cards say, "You have been sprayed and are terminated. Please sit down." The other five cards can read, "Congratulations! You survived the spraying." Have students calculate the percent survival (those living divided by the total number in class, then multiply by 100%).

Have those students sitting down come forward again, and explain that five individuals reproduced, and they are the new colony. They are munching on the crops again, and they will be sprayed again with the same concentration. Have them draw from the bag again. This time place ten survival cards in the bag. Again have them calculate percent survival.

This activity can then be expanded by announcing that because of the increased survival, a larger concentration will be sprayed (20 mg/kg body weight). Repeat the above sets of five and again with 10 survivors. If any "student" survives all sprayings, see if the class can calculate the amount of pesticide he/she has received. This could be done for an average student weight of the entire class such as 70 kg.

Discuss the options of the farmer and ask how the students would handle this problem if they were a farmer. This could include leading questions about costs, risks, benefits, alternative means of control....

Bioconcentration

As pesticides are passed up the food chain, their concentration in the higher consumers tend to increase. This activity needs to be preceded by an explanation of the food chain or food web. A bulletin board may prove useful as a teaching aid or transparencies of various food chains/webs can be used.

Have the students withdraw labels on 3 x 5 cards out of a large grocery bag. The labels should be as follows: two cards, human; four cards, big fish; eight cards, fish and the remainder insect. Extra insect cards may be required for meaningful amounts of pesticides to be passed up the food chain. Have the students hold up their animal label. Divide the classroom with an imaginary line, and explain that the fish are to stay in the "water". Tell the insects that they have been sprayed and hand them a card that reads "Pesticide". They are to "fly" to the "water," where they are "eaten" by the big fish. This is done by the insects giving the big fish their label/card. The big fish are then "caught" and "eaten" by the humans who collect all of the pesticide cards. Inform the "fish" and "humans" that if they receive more than 10 pesticides cards they are to "die", and withdraw from the chain. The number of pesticide cards received resulting in death may be varied depending on the number of students involved.

Ask them to develop an explanation of bioconcentration based on this activity.

ADDITIONAL ACTIVITIES

A collection of news articles related to pesticides can be initiated. The articles should be properly annotated and grouped according to type of pesticide.

Select one of the pesticides found in the home survey, and have one of the students research the specifics on it. This could include target pest, route of action, how it was produced, how it is applied, who are the major consumers, and how effective it is.

Have a speaker from the State University Extension Agent Service discuss the pros and cons of pesticide use from a farmers point of view.

Read and report on a book such as Silent Spring .

Report on various natural pest control methods such as screw worm sterilization via radiation, natural predators, use of preying mantids and lady bug beetles.

VOCABULARY

Agribusiness, bioaccumulation, bioconcentration, DDT, Chlordane, herbicide, pesticide, immunity, insecticide, metabolism, natural selection, forced evolution, pest, toxin

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SAMPLE LETTER TO PARENTS FOR PESTICIDE SURVEY

November 00, 1985

XXXX Middle School
2901 School Avenue
Seven Oaks, Virginia 00000

Dear Parents:

Our science class is exploring the topic of pesticides as a unit. Part of this exploration is the safe handling of pesticides around the home. Please assist your child in filling out the enclosed survey form. These forms will be used to compose general safety and handling rules that may then be posted for quick reference.

Please note that in no way are we asking your child to use or even handle these chemicals but simply to locate and identify them.

The surveys are to be returned to class by November xx, 1985. (Date).

Thank you.

Sincerely yours,

Jackie Smith
Science Teacher

ACKNOWLEDGMENTS

This edited version was based on the original materials developed by Gerald Evans from Lloyd C. Bird High School in Chesterfield County, Elizabeth D. Leonard formerly with Hanover County Schools and Laura George with St. Michaels School, Bon Air, VA.

KILL - A - BUG®

PATIO, PORCH & GARDEN INSECT SPRAY

USE INDOORS OR OUTDOORSCONTROLS MOSQUITOES**EASY TRIGGER SPRAY**

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

DISPOSAL

Do not reuse empty container. Wrap container and put in trash collection.

TO OPERATE: Turn nozzle to "spray" or "stream" position before using. Nozzle should be 6-8 inches from surface being sprayed. Spray infested surface until wet.

TO CONTROL: Insects named, thoroughly apply spray to upper and lower leaf surfaces. Repeat treatment weekly or as needed to control infestations.

TO CONTROL: Adult mosquitoes, apply fine mist to shrubs and vegetation around patios and porches where mosquitoes may rest.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS: CAUTION: Harmful if swallowed or absorbed through skin. Avoid breathing vapors. Avoid contact with eyes, skin or clothing. In case of contact, immediately flush eyes and skin with plenty of water. Get medical attention if irritation persists. Remove pets, birds and cover fish aquaria before spraying.

ENVIRONMENTAL HAZARDS

This product is toxic to fish. Keep out of lakes, streams, ponds, tidal marshes and estuaries. Do not contaminate water by cleaning of equipment or disposal of wastes. Shrimp and crab may be killed at application rates recommended on this label. Do not apply where these are important resources.

MADE IN U.S.A.
ANYTOWN, OHIO 11111

Buyer assumes all risks of use, storage and handling of this material not in strict accordance with directions given herewith.

EPA REG. NO. 4816-482-3696

EPA EST. 3696-OH-1

0 5482 ©1979

Pesticides Are Poisons

Read the Label!

Pesticides can injure and kill. They can harm the environment. They must be used carefully and intelligently. Make sure you:

1. Look for the *EPA registration number* on the product label. This assures you that the pesticide is safe and effective when used according to label directions.
2. Read the *directions* thoroughly. Use only the exact amount directed, at the time and place specified, and only for the purpose listed. *Don't* think that twice the amount called for will do twice as good a job—it won't. This misconception can do great *harm* to you or to what you are trying to protect.
3. Read the *precautions*. Those pesticides with the highest degree of toxicity are marked with a skull and crossbones and state DANGER-POISON; the word WARNING signifies that the pesticides are less harmful; and CAUTION means that they are the least harmful.
   Pay special attention to instructions such as that children and pets should not be permitted in the sprayed area until it is dry. Heed any advice about wearing protective clothing and note what to do if the pesticide spills on your body or clothing.
4. Observe the *ingredient* statement and *first aid* instructions. If an accident does occur, take a copy of the label to your doctor or hospital.
5. *Store* the product in a safe place and in the original container. Never transfer a pesticide to a soft drink bottle or any other container that may be attractive to children.
6. Dispose of empty containers according to label instructions.

By studying and heeding all instructions on a pesticide label, you can save yourself and your children from serious accidents. You should also remember the potential effect of pesticide misuse on the environment. By contaminating air, soil, and water resources, pesticides can pose a threat to plants, animals, and indirectly to man himself.

Protect yourself,
your children,
and the environment!

Read the Label!

Acid Runoff: A Case Study And pH/Oxidation Experiment

MAJOR PURPOSE

- *To illustrate the ecological importance and relationship between acidity and aquatic systems
- *To emphasize the need for proper disposal procedures for waste products
- *To show an example of the problems that rain water runoff has caused at a copperas site

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS/QUESTIONS

- *To increase environmental awareness of runoff from waste sites
- *To show the importance of aquatic pH levels
- *To provide the background on a copperas waste site as a Superfund project
- *To demonstrate oxidation-reduction
- *To emphasize the need for more industrial responsibility in disposal of waste products
- *To undertake a laboratory experiment demonstrating pH change & oxidation

INSTRUCTIONAL APPROACH

The general science or physical science class studying acidity and pH would be a suitable and logical place for the inclusion of this material and demonstration/laboratory. The hydrogen ions available for chemical reaction in a particular medium, the idea of oxidation-reduction and an introduction to the pH scale all complement the environmental aspects of this problem. The effect of such runoff on an ecosystem would be a natural follow-up.

It is suggested that following the introduction of pH and related topics that the teacher present a historical background on the development of the copperas waste site, including the geographic location, the economic aspects of the problem and the attempts to remedy it. The roles of the State Water Control Board, the responsibilities of industry, and the importance of the Superfund should be explored. Possibly a speaker from the State Water Control Board could enlighten the class on the latest developments relating to this site. State Department of Health Officials also have an interest in the site.

The changing of ferrous sulfate to ferric sulfate with resultant pH measurements and color changes can be either a teacher demonstration or a class laboratory activity capable of completion within one class period.

The teacher should summarize the experiment and emphasize the need for correct disposal of such wastes via secure landfill or recycling. The environmental and economic aspects of the site should provide the basis for a final discussion.

OVERVIEW/BACKGROUND/CASE HISTORY

Most organisms survive at only narrow limits of acidity, usually between pH 6 and 8. Aquatic organisms are very sensitive to changes in the pH of their surroundings. Water below pH 5 and above pH 9 levels affects the ability of most fish to extract oxygen from the water. Trout are very sensitive to a pH of less than 5.6 and do not reproduce at such levels.

One of several major reasons for low pH levels in our waters is industrial discharges or landfill seepage. For example, one Virginia site that has caused acidic runoffs is a disposal pit of copperas waste in the Piney River area of Nelson County. This river is a major tributary of the James. At the Piney River Gauging Station, the river pumps into the James about 56 million gallons per day. As you are aware the James empties into the Chesapeake Bay.

Copperas is actually ferrous sulfate, $FeSO_4$, a crystal that has a copper color. It is a by-product in the production of titanium dioxide, TiO_2, a paint pigment. American Cyanamid, situated on 80 acres adjacent to Piney River and Route 151 produced this pigment over a 20-year period ending in 1969.

Sulfuric acid was used by American Cyanamid to react with ilmenite ($FeTiO_3$, a brilliant black mineral), an ore containing iron and titanium. This reaction results in a solution of titanium sulfate and ferrous sulfate. Oxidation of ferrous sulfate to ferric sulfate, $Fe_2(SO_4)_3$, occurs in the presence of air and water, resulting in the generation of titanium dioxide (TiO_2), crystal ferric sulfate and acid washings.

Many companies use sulfuric acid, H_2SO_4, in the cleaning or "pickling" of metals and metal ores. Historically, sulfuric acid has been used as a barometer of economic health: the more acid used the healthier the economy. Environmental health, however, seems to be inversely related to the amount of such acid present in aquatic ecosystems.

Towards the end of the American Cyanamid operation in 1969, the acid washings were neutralized in two lagoons on their site and discharged into the the Piney River. Some ferrous sulfate, copperas, estimated at 25,000 tons was dumped into the river. Eight hundred and ten thousand tons were deposited on a slope or hillside area of eight acres. Soil around this site was later tested and found to be at the 2-3 pH level. Rain water has washed these tailings. The State Water Control Board found five miles of the Piney River below the plant to be sterile. The aquatic environment was destroyed. When faced with treating the river or closing, American Cyanamid chose the latter.

U.S. Titanium assumed ownership of the site in 1976, and in doing so, assumed responsibility for handling the wastes. The new owner was ordered to dispose of the copperas by December, 1980 and consequently spent $340,000 on removal of the waste from the slope to a 10 acre disposal pit area. Burial was not conducted in compliance with State Water Control Board requirements, and a number of large breaks in the cover material was caused by settling. Leaching was observed also. Since 1977, the State Water Control Board has documented fish kills totalling over 600,000, the majority being trout and other game fish. Tests of the pH levels were taken at four sites on the river on August 27, 1979. Those readings were:

Above U.S. Titanium at Route 151 Bridge ---- pH 5.0
Lower Lagoon below the plant --------------- pH 2.1
Discharge from drainage area --------------- pH 2.9
Downstream at Route 674 Bridge ------------- pH 4.6

Similar pH levels were found in several samples taken in repeated testing. Runoffs caused by rain water from the lagoons and discharge from the pit were responsible for fish kills as late as May and June of 1981. The lagoons or tailing ponds continue to cause problems as reported by the Virginia Department of Health on September 21, 1982.

The problem of reclamation has been compounded since U.S. Titanium recently defaulted on its loan, leaving the Stone Foundation holding all of the stock. The State of Virginia is suing both companies to recover the cost of testing and re-stocking the river with fish. The Superfund legislation of December, 1980 authorized the federal government to respond directly to hazardous substances that may endanger public health or welfare. The Piney River copperas waste site is one of those being considered by EPA authorities. Approximately $300,000 is needed to clean the slope, pit and lagoon areas. At this date, negotiations are continuing in the suit.

NOTES AND INFORMATION FROM GUEST SPEAKER/TELEPHONE INTERVIEW

MATERIALS NEEDED FOR THE FOLLOWING ACTIVITY

Ferrous sulfate, beakers, pH paper (1-8 range), hot plate, distilled water, safety glasses

ACTIVITY--DEMONSTRATION/LABORATORY

The Oxidation of Ferrous Sulfate to Ferric Sulfate and Concurrent pH Changes

Determine the pH of your distilled water. (Tap water will suffice if distilled is not readily available.) In beaker A, place 2-3 grams of ferrous sulfate, $FeSO_4.7H_2O$, in 50 ml of distilled water and stir again after every 2 1/2 minutes. Immediately test with pH paper. The reading should be about 5. Allow this solution to sit for 45 minutes measuring the pH every 5 minutes. At the end the pH should be near 2. Place a similar amount of ferrous sulfate and water in beaker B and begin to evaporate it slowly on a hot plate. Note any color changes every 5 minutes. Be sure to determine pH right before crystallization. Compare the greenish-blue (very light) color of ferrous sulfate with the reddish-brown (very light) of ferric sulfate. Ferrous sulfate undergoes slow oxidation in the air or rapid oxidation when added to water and heated. Compare this to the oxidation of iron metal, aluminum metal, burning magnesium, a flash bulb......

DATA TO BE RECORDED

Original pH of the distilled water: ________

pH of water with 2 grams ferrous sulfate and 50 ml water:
Beaker A ________ Beaker B ________

pH of Beaker B at the end of class: ________

Color of beakers at the beginning of class: Beaker A ______ Beaker B _____

Color of beakers at the end of class: Beaker A _____ Beaker B _____

Actual Data Collected:

Beaker A	Color	pH	Beaker B	Color	Time Elapsed
					0 min
					5
					10
					15
					20
					25
					30
					35
					40
					45

FOLLOW UP ACTIVITIES

Both the teacher and student are reminded to dispose of the remaining materials from the laboratory via proper procedures which usually means that these wastes will go to a landfill and not down the drain. The sharing of this concern and procedure with the students may be of value.

The instructor may want to review ahead with the students some aspects of the experiment and also discuss the enviromental problems associated with the problem at Piney River. A series of maps have been included for your use. It is fair to note that many other areas in the country also have copperas disposal problems, and that a search of your own locality may turn up such conditions very close to home.

Students may be asked to locate the Piney River and Route 151 on the maps. You may request that they use a marker to trace the path of the water to the Atlantic Ocean. Ask the students to determine if any communities along this pathway draw their drinking water from the rivers involved.

If a guest speaker cannot be arranged from a state agency why not consider a telephone interview by either teacher or student with such specialists to provide the latest information relating to the problem.

REFERENCES

Data Summary, Nelson County, Div. of State Planning & Community Affairs. Richmond, VA.

Richmond Times Dispatch, "Much of Mine Waste Still Near River," March 20, 1978, "State Expected to Obtain Little of Superfund," March 27, 1983.

State Water Control Board Files, 1977-1983, Richmond, VA.

Water News, Virginia Water Resources Research Center, Blacksburg, VA. Vol. 13, Jan. 1982; Vol. 13, March 1982; Vol. April 1982; Vol. 13, June 1982; Vol. 14, July 1983.

Water Quality Inventory (305 Report), 1975 Report to EPA & Congress, Information Bulletin 509, Virginia State Water Control Board, Richmond, VA.

SAMPLE VOCABULARY

pH, oxidation-reduction, sterile, copperas, ferrous sulfate, ferric sulfate, acid runoff, Piney River, Nelson County, VA, titanium dioxide, leaching, fish kills, Superfund, lagoon, hydrogen ion, ilmenite

Figure 1. A Map Of Nelson County, Virginia Showing The Piney and Tye Rivers And Route 151.

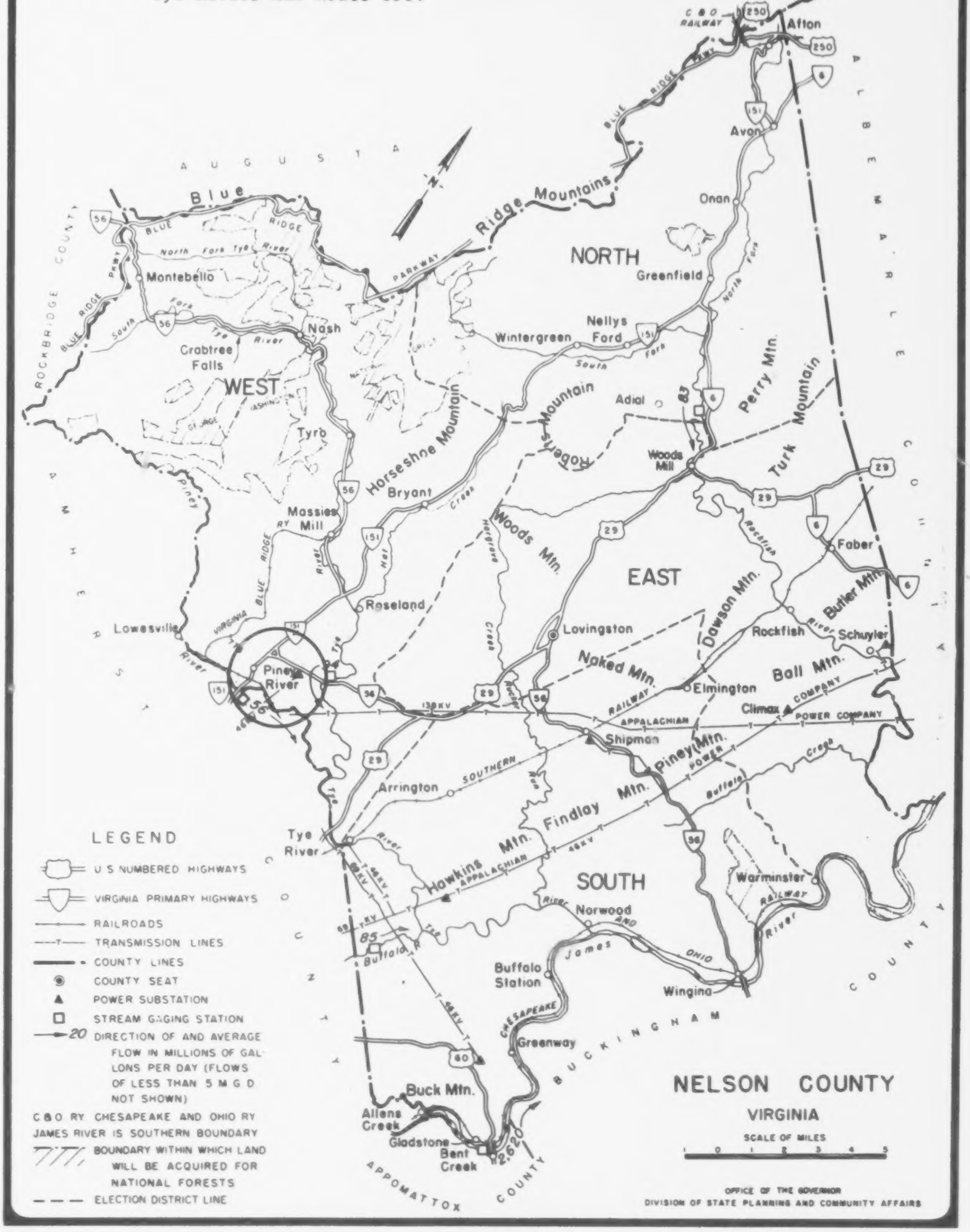
NELSON COUNTY
VIRGINIA
SCALE OF MILES
1 0 1 2 3 4 5
OFFICE OF THE GOVERNOR
DIVISION OF STATE PLANNING AND COMMUNITY AFFAIRS
LEGEND
U S NUMBERED HIGHWAYS
VIRGINIA PRIMARY HIGHWAYS
RAILROADS
TRANSMISSION LINES
COUNTY LINES
COUNTY SEAT
POWER SUBSTATION
STREAM GAGING STATION
20 DIRECTION OF AND AVERAGE FLOW IN MILLIONS OF GALLONS PER DAY (FLOWS OF LESS THAN 5 M G D NOT SHOWN)
C&O RY CHESAPEAKE AND OHIO RY
JAMES RIVER IS SOUTHERN BOUNDARY
BOUNDARY WITHIN WHICH LAND WILL BE ACQUIRED FOR NATIONAL FORESTS
ELECTION DISTRICT LINE
AUGUSTA
ALBEMARLE COUNTY
ROCKBRIDGE COUNTY
AMHERST COUNTY
BUCKINGHAM COUNTY
APPOMATTOX COUNTY
NORTH
WEST
EAST
SOUTH
Afton
Avon
Onan
Greenfield
Nellys Ford
Wintergreen
Adial
Woods Mill
Faber
Schuyler
Rockfish
Elmington
Climax
Shipman
Lovingston
Roseland
Bryant
Massies Mill
Tyro
Nash
Crabtree Falls
Montebello
Lowesville
Piney River
Arrington
Tye River
Norwood
Warminster
Wingina
Buffalo Station
Greenway
Buck Mtn.
Allens Creek
Gladstone
Bent Creek
Blue Ridge Mountains
Horseshoe Mountain
Roberts Mountain
Perry Mtn.
Turk Mountain
Woods Mtn.
Dawson Mtn.
Butler Mtn.
Naked Mtn.
Ball Mtn.
Piney Mtn.
Findlay Mtn.
Hawkins Mtn.
James River
Buffalo R
Rockfish River
Tye River
Piney River
C&O RAILWAY
SOUTHERN RAILWAY
APPALACHIAN POWER COMPANY
250
151
6
56
29
60
83
65
2,620
138KV
46KV
69KV

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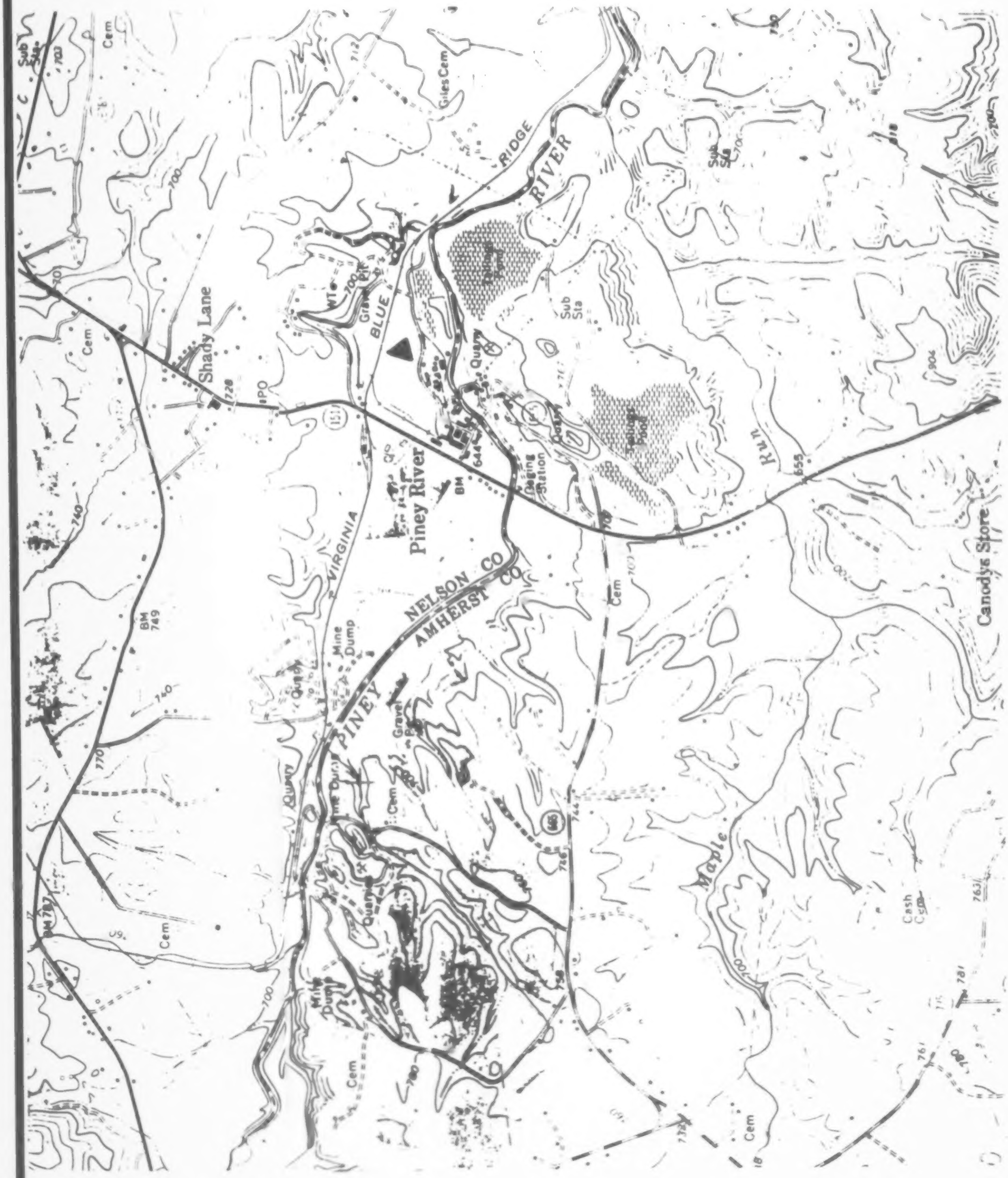
Figure 2. A Topograhic Map Of The Copperas Runoff Site Showing Piney River, Tailing Ponds, Quarries, Mine Dumps, Gauging Station And Gravel Pit.


Shady Lane
Piney River
BLUE RIDGE
RIVER
VIRGINIA
NELSON CO
AMHERST CO
PINEY
Tailings Pond
Tailings Pond
Sub Sta
Sub Sta
Quarry
Gauging Station
Mine Dump
Mine Dump
Gravel Pit
Quarry
Giles Cem
Cem
BM 749
Maple
Run
Canody's Store
151
644
655

▲ U.S. Titanium

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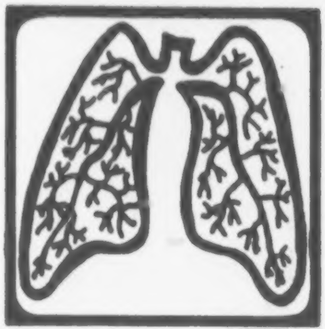
ACKNOWLEDGMENTS

This edited version was originally developed and evaluated by Jo Ann L. Hilldrup, a faculty member of Mills E. Godwin High School, Richmond, VA. Maps are copies from State of Virginia. Dept. of Planning and Community Affairs and other State of Virginia sources.

NOTES AND ADDITIONAL INFORMATION

Spirometry: Breathing, Lung Measurements, And Diseases



MAJOR PURPOSES

- *To introduce the importance of spirometry and lung biology
- *To provide background material about respiratory diseases which influence breathing ability
- *To compare healthy individuals to people with asbestosis, mesothelioma or other lung diseases

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS/QUESTIONS

- *To identify and test for various lung values including forced vital capacity
- *To illustrate the relationship between lung disease and lung volume measurements
- *To provide details for the use and construction of spirometers
- *To collect laboratory data illustrating the concept of vital capacity

INSTRUCTIONAL APPROACH

This lesson discusses spirometry in general and describes the use and construction of several simplified spirometers and their use as teaching aids in the study of the human respiratory system. The topic is suitable for life science, general science or biology classes. At the outset the teacher may want to provide some general information about spirometry - the measurement of lung volumes. This presentation could include the forced vital capacity (FVC) and a brief overview of some of the major lung disorders which are caused by hazardous materials. Among these disorders are asbestosis, mesothelioma, emphysema, and black lung. Spirometry and lung disease should then be tied together with comments about the general decline in lung function that occurs as a result of these disorders.

After presenting the instructions for the use of the spirometer, the students' FVC's can be determined. The values should be entered in a data table and the readings compared with the normal values from the Spirometric Standard Chart (Morris et al., 1971). A sample of the data table and the nomogram which is used is presented later. This is provided so it may be easily duplicated. While some students are determining their vital capacity, another activity should be planned for the remaining students. This could include some written work at their desks, such as their searching for answers to topic-related questions and definitions or a puzzle activity like the one included later.

Several types of spirometers are available including the water displacement type (some just use water as a seal to trap the air), the bellows type, the tube expansion type, and a metered wheel (dry) type. Some schools may have a wet-type spirometer (usually a set of cans and water or water sealed tanks as shown in Figure 1). This is the type we will base our instructions upon, but they could just as well apply to the other types. The spirometer can be set up on one laboratory table, and the students would use it once and then return to their seats and work on their calculations and other materials.

Do not allow students to determine their FVC repeatedly. There is a danger of hyperventilation. A wise procedure would be to have each student who wants to participate to return to his/her desk after one test. They could repeat the test later in the period or the next day for more statistically valid results. It is suggested that at least three sets of data be collected. It is not suggested that students be required to participate. Non participants can share and use the data from others or that supplied by the teacher.

Spirometry experiments usually require the use of special instruments, which may be too expensive for the typical middle school science department. If one can not be purchased, borrowed from a high school or college, or a local Heart and Lung Association, the construction of a spirometer as a project can create student interest and encourage learning.

The response of most students to the experiments outlined here has been encouraging. Students will be interested in measuring their FVC, and they actually will compete for maximum displacement. At times they will exhale with such vigor the teacher may have to restrain any superhuman efforts. Athletes are always inquisitive about their vital capacity. Distance runners, of course, usually have a very good FVC. Please emphasize that the FVC is relative to each student's physical dimensions and thus girls who are normally smaller, are expected to have less lung capacity (Llewellyn, 1971).

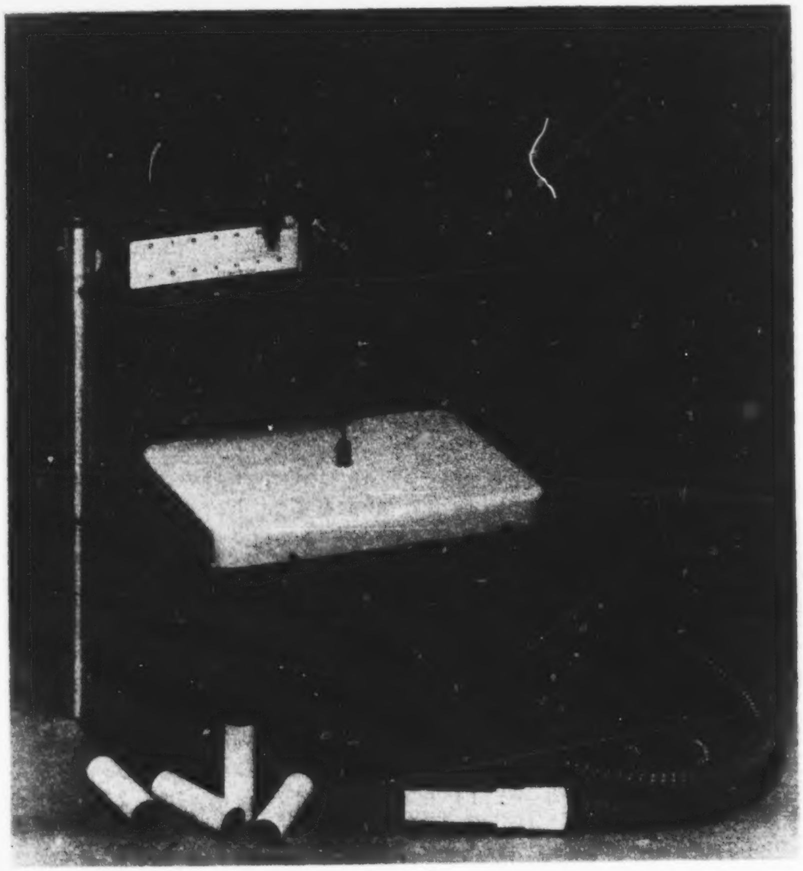
The teacher should not "play" physician and it should be emphasized that if the FVC is lower than expected (85% of the chart value), it does not necessarily mean that the person has lung disease. The 85% value is used by most practicing medical professionals who deal with respiratory determinations. There are many variables in this classroom "testing" situation and a true medical diagnosis can only be properly evaluated by a medical specialist with medical-quality equipment. It is suggested questionable students be retested by a professional or by their physician.

OVERVIEW/BACKGROUND

The study of the human lung through spirometry has become increasingly interesting to the layman and student. This may be due, in part, to news about smoking and lung cancer, the effect of high altitude on athletes, and the rising incidence of respiratory diseases related to pollutant exposure. The main respiratory diseases related to pollutant exposure include asbestosis and mesothelioma, emphysema, brown lung and black lung.

Lung damage is associated with diseases such as asbestosis, mesothelioma. Health hazards associated with asbestos were identified in the late 1800's. Large numbers of workers were exposed to asbestos in the ship building industry during World War II and this continued into the early 1970's until the public finally became aware of the problems associated with asbestos.

Figure 1. Picture of a Wet Spirometer. This one is a student model we helped Phipps & Bird (now General Scientific, Richmond, VA) to design.



The first sign of asbestosis appears to be "asbestos warts" in the lung epidermis. Asbestotic pneumonoconiosis is also associated with the patient. After long periods of time mesothelioma of the lung tissue can result in some cases, the latter being a highly specific type of lung cancer almost exclusively associated with asbestos. The disease tends to progress and cause disability. Measurements of vital capacity and chest X-ray offer the best hope for screening people with potential exposure to asbestos (Plunket, 1976; Council on Scientific Affairs, 1984).

Chronic emphysema of the lungs has become the number one respiratory disease in the United States, affecting nearly 10 million Americans with the typical victim being a male of 40 years or over. It now is the cause of more deaths than lung cancer and tuberculosis combined, and the mortality rates continue to rise. Exposure to heavily polluted air, dusts, spores, and various chemicals aggravates the lung disorders that lead to emphysema. It is estimated that at least 25% of all cases of the disease are occupational-related. Emphysema can best be prevented by maintaining good health and giving prompt attention to any lower respiratory illness, especially bronchitis or asthma. A chronic cough should be treated by a physician. Obviously the decreased breathing ability of somebody suffering from this condition could be screened during periodic measurement of vital capacity (Fishbein, 1979).

The lung capacity devices discussed here may be classified as wet spirometers if they use water as a seal or displacement medium. Construction details are given later. In this type of common device, air is exhaled through a large-bore tube. It displaces the water and this forces the smaller tank to rise to a level proportional to the volume of air within it. Other types of spirometers include the wheel-measurement (dry) type as produced by Propper and the bellows expansion type. The plastic bag expansion types are modifications of the latter. All of these types require that some type of sanitation be provided at the point of mouth contact. This is usually done with the aid of a disposable cardboard cylinder, but we recommend the use of an inexpensive sandwich bag with a hole in it. Such a bag can cover the mouth piece and be disposed of after each student determination. Further details concerning the use of plastic bag expansion spirometers will be presented later.

Natural breathing, eupnea, is a quiet process, accomplished with ease. The air that the human being exchanges in normal breathing is known as tidal air. Tidal air represents a small percentage (about 10%) of the air that can be inhaled during deep breathing. The normal tidal volume (TV) is about 500 cc at a breathing rate of 12 exchanges a minute in the adult. At birth, the breathing rate is very rapid, 40 to 70 times per minute. At age one it has decreased to 35 to 40 exchanges a minute. At five years of age it is 25, at age 10 it is about 20, and at 25 years it is 16 to 18 times per minute (Pace et al., 1965). Women breathe a little more rapidly than men, approximately 2-4 more respirations a minute, but the tidal air of the female is less than that of the male. In a given period the male breathes more air than the female. The male usually has more body mass, requiring a greater need for oxygen.

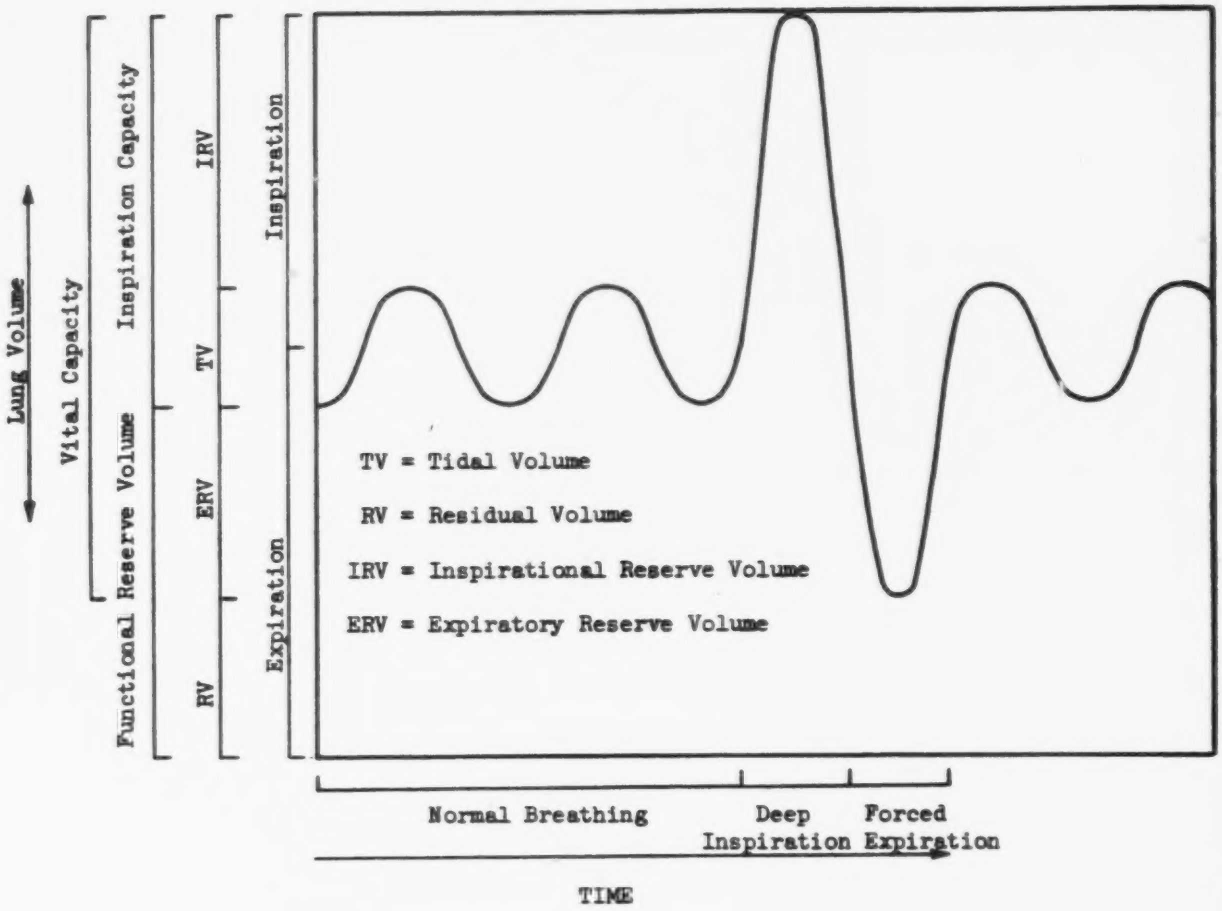
Vital capacity or FVC is a measure of the subject's overall ability to breathe. In breathing, two important factors are the strength of the respiratory muscles and the resistance of the thoracic cage and lungs to expansion and contraction (Guyton, 1983). If the expanded chest is measured with a tape measure, the reading may bear a minimal relationship to the vital capacity. A subject with powerful chest muscles is capable of enlarging his/her thoracic cavity to a volume greater than his/her lungs are able to fill. At this time the diaphragm is drawn upwards and the viscera move into the thoracic cavity, due to a strong contraction of the abdominal muscles (Langley and Cheraskin, 1965). Together, the value of vital-capacity measurements in assessing the functional ability of the lungs is evident. Such values and those for each inspiration and expiration are shown in the spirogram in Figure 2 (Llewellyn, 1971).

Lung diseases and the application of the concepts relating to the wet spirometer have become an item causing substantial concern to educators. It seems that asbestos was used in the construction of many of our school and college buildings.

Federal law requires that school officials have their schools inspected and that a qualified technical laboratory report on the inspection be kept on file in the school office. If asbestos is found, the school must also make a reasonable effort to inform parents and parent-groups. For additional information about asbestos in schools, school officials may call the EPA at their toll-free hotline, 1-800-424-9065. They will be helpful (EPA Hotline).

The science teacher could take a leadership role in this inquiry concerning asbestos in your school. You should be able to describe the general appearance of friable asbestos to your colleagues or students and have them look for it. Please do not expose them to the actual samples. They could also search for materials that have been sprayed on ceilings, walls and girders and pipe insulation. Remember that only a qualified laboratory can make an exact determination. You can ask the students to survey the buildings of the school and community and report back to you at the next class. You may ask the school office to see a copy of the asbestos report. We recommend that you be cautious as you investigate this highly political and sensitive topic (Baggett, 1984).

Figure 2. A Spirogram With Indicators of Volume Designations Commonly Used in Spirometry (Llewellyn, 1971).


Lung Volume
Vital Capacity
Inspiration Capacity
Functional Reserve Volume
IRV
TV
ERV
RV
Inspiration
Expiration
TV = Tidal Volume
RV = Residual Volume
IRV = Inspirational Reserve Volume
ERV = Expiratory Reserve Volume
Normal Breathing
Deep Inspiration
Forced Expiration
TIME

HOW TO USE THE WET SPIROMETER

1. Have the student punch a hole in a plastic sandwich bag with his/her finger and place it over the mouthpiece. Obviously, an antiseptic could be used to wipe the mouthpiece, but we believe the disposable bag method will work best when it is placed over the already disposable cardboard mouthpiece. Cardboard mouthpieces are expensive, costing about $10.00/100.

2. The student should inhale forcefully and fill their lungs to the maximum. It is recommended that they practice a few non-forceful inhalations before the actual measurement.

3. After a maximum inhalation the student should exhale into the mouthpiece of the tube.

4. The teacher and student should determine from the scale or calibration, the forced vital capacity. Only one measurement should be undertaken during a test. Additional measurements may be spread over the class period or during the following class meeting.

5. After recording this data in the data table and after several tests have been completed, use mean values to compare to the expected value based on the nomogram-generated values. Figure 5 illustrates a nomogram.

6. As a special caution, it is important that the students not undertake several very vigorous forced vital capacity tests in a short time periods of say 30 seconds to two minutes. They could hyperventilate.

PLASTIC BAG EXPANSION SPIROMETRY

This can be substituted for the wet spirometer. There are several kits available from various manufacturers that measure lung volume by having the subject exhale into a plastic tube of some type and then folding the bag to read a numbered interval printed on the tube. Hubbard (P. O. Box 104, 1946 Raymond Dr., Northbrook, IL 60062) manufacturers the device shown in Figure 3. It is reusable and the disposable sandwich bags can be used over the mouthpiece. One of their projects, "Health activities Project" uses the device to measure both vital capacity and tidal air since it does have a valve system. Figure 4 illustrates how to use their device. It shows how to squeeze the air-filled tube and twist it so a reading can be taken. It also shows how to empty the bag for reuse.

We also suggest that you consider using a clean bread bag or newspaper delivery bag. It is disposable but will need calibration. Students may bring their own sample bag from home and calibrate it with a known volume of water.

Figure 3. Lung Volume Measurement Bag As Manufactured By Hubbard.

Figure 4. Suggestions As To How To Measure and Empty the Lung Volume Bag.

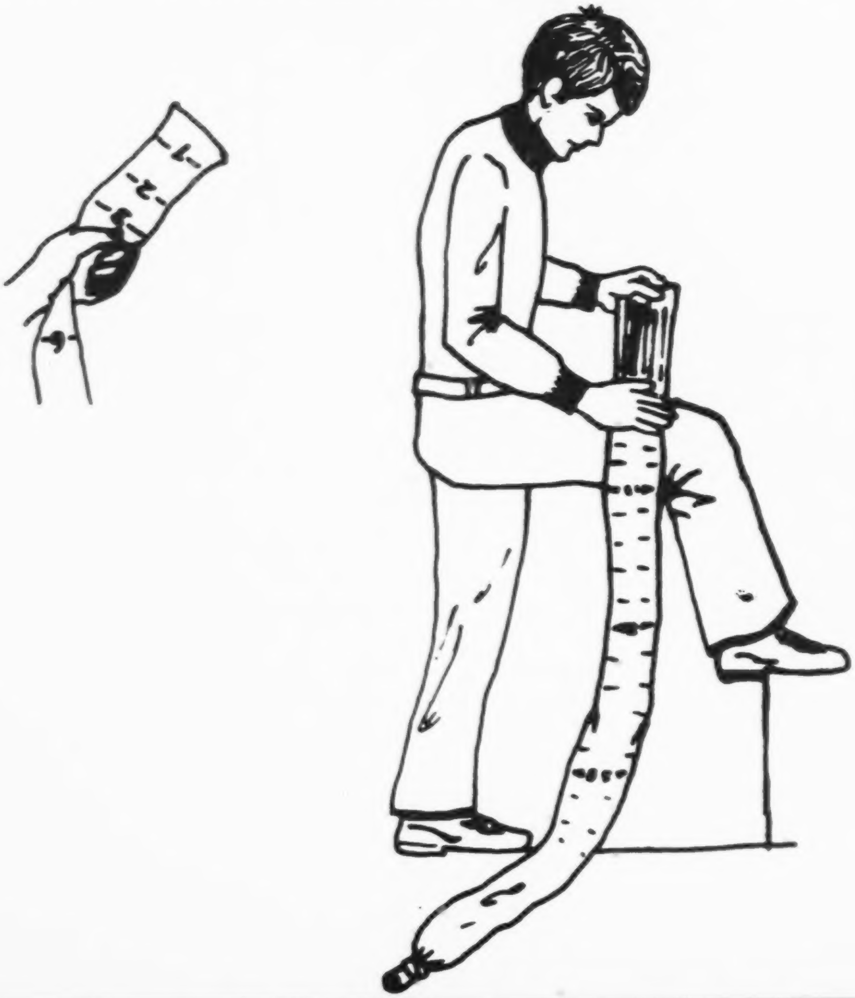


Table 1 . Sample Practice Data Chart and Nomograms for Determining Forced Vital Capacity.

Test #	Measurement of FVC	(0.85 x Normal FVC)	Normal FVC From Nomogram
1	4.50 liters	---	4.66
2	4.30	---	4.66
3	4.70	---	4.66
Mean	4.50 liters	3.96	4.66

The normal values of FVC are determined by connecting the values of height and age with a straight edge and reading the values from the scale on the far right for the normal (expected) FVC. This is illustrated in Figure 5.

Conclusion for the above sample practice data the student appears to have a FVC within 15% of the expected value as based on current height and age. This nomogram is the one typically used by the American Heart and Lung Association.

Table 2. Data Chart and Nomograms for Determining Forced Vital Capacity.

Test #	Measurement of FVC	(0.85 x Normal FVC)	Normal FVC From Nomogram
1	liters	---	
2	liters	---	
3	liters	---	
Mean	liters		

Figure 5. Sample Nomogram for Determining Normal Values of Forced Vital Capacity in Males.

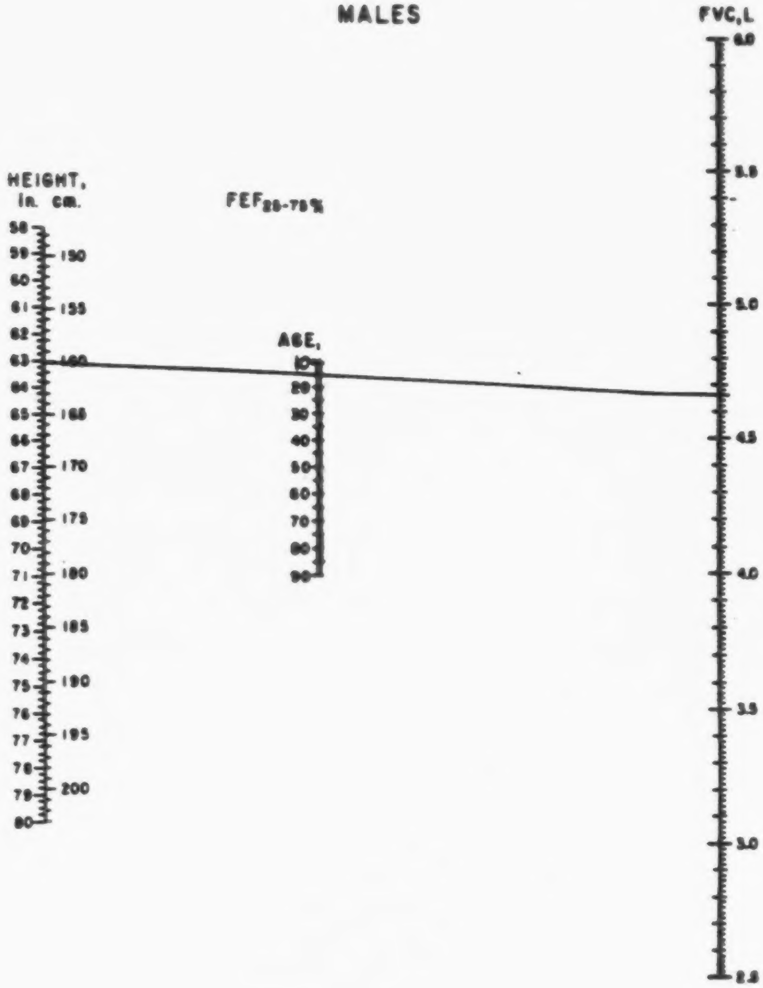


Figure 6. Nomogram For Determining Normal Values of Forced Vital Capacity in Males.

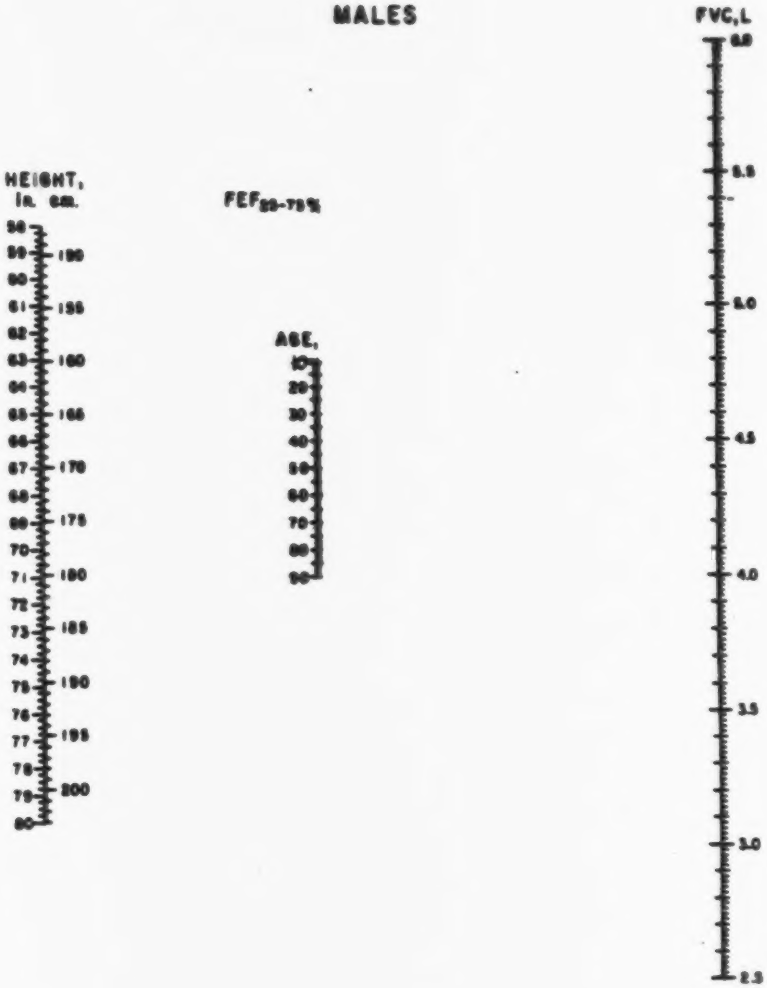


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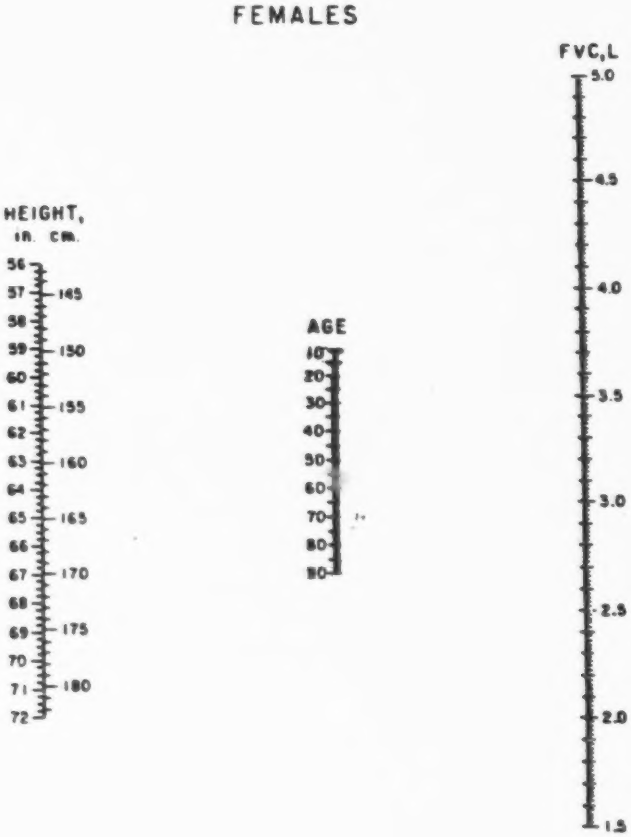
Figure 7. Nomogram For Determining Normal Values of Forced Vital Capacity in Females.



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BUILDING A WET SPIROMETER FROM METAL TRASH CANS

1. Locate two cylindrical cans which have sizes that will permit one to fit inside the other like a piston in a cylinder. The volume of the largest can should be six to eight liters. Use only containers that have straight vertical sides.

2. Cut a hole through the bottom of the larger can and drill a hole for the hose through the plywood base. Insert appropriately sized plastic plumbing fittings into the hole and seal the opening with silicone sealant. Attach a hose to the pipe on the outside and extend the pipe on the inside using a straight section of plastic pipe and glue.

3. The hose may be a disposable respiratory hose purchased from a medical supply house or a new vacuum cleaner hose or a garden hose. Refer to Figure 8 for details of construction (Llewellyn, 1971).

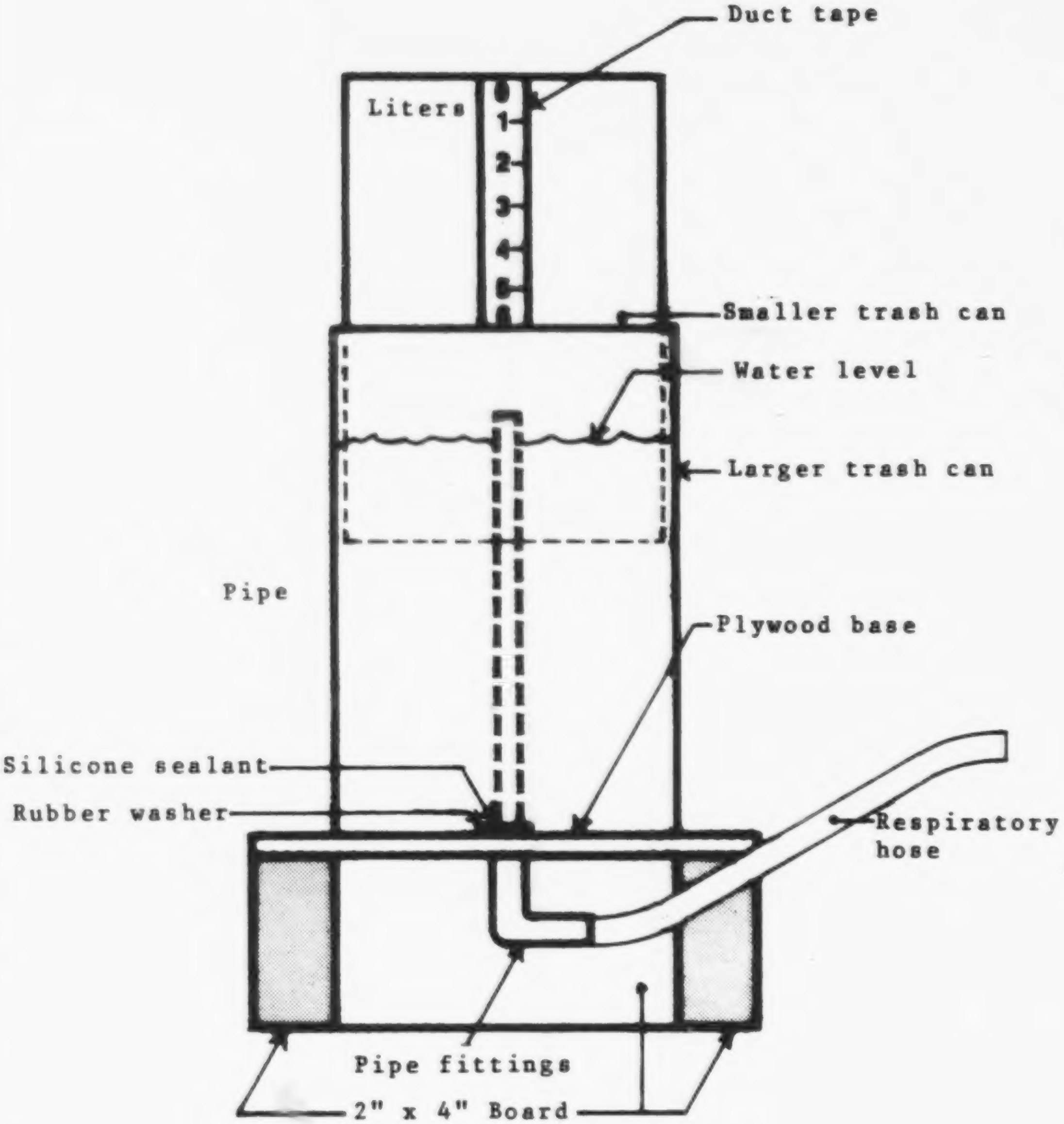
4. Nail three pieces of 2 inch by 4 inch to the plywood base. Nail a third piece of 2 inch by 4 inch across the back. Attach the plywood base with epoxy glue to the bottom of the large trash can.

5. Consider sealing any of the joints or seams on the metal cans with silicon sealant.

6. Drill a 1 cm hole in the bottom of the smaller can and use a rubber stopper or piece of heavy electrical tape to seal it. This is the discharge vent.

7. Calibrate the "instrument" by determining the volume of the smaller can in 1 cm vertical steps. Mark these volumes or a scale on the smaller can starting from the bottom end. Volumes should begin with 1 liter and go to 7 liters. An easy way to calibrate the can is to simply add water to it in 250 ml quantities and mark the height on the outside. A ruler will help. This could also be done by using the standard formula for the volume of a cylinder (V= area of base times the height). The scale may be written on a piece of duct tape placed on the side of the can.

Figure 8. Side View of A Home-Made Wet Spirometer


Duct tape
Liters
0
1
2
3
4
5
Smaller trash can
Water level
Larger trash can
Pipe
Plywood base
Silicone sealant
Rubber washer
Respiratory hose
Pipe fittings
2" x 4" Board

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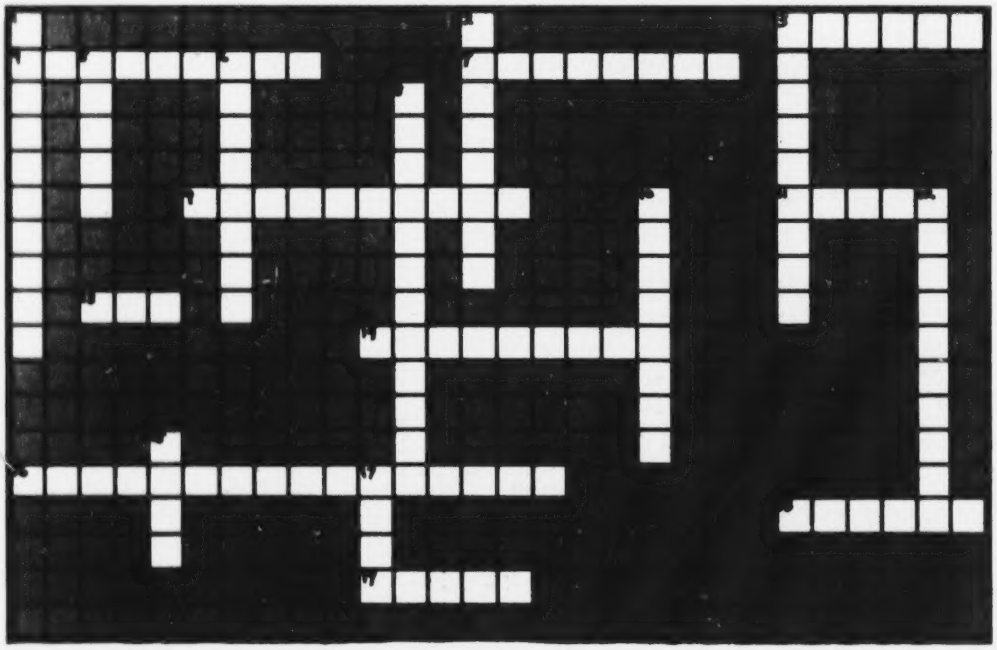
SPIROMETRY AND LUNG DISEASE PUZZLE

Across

3. Natural breathing   4. Concerned with the lungs   7. General name for a number of thread-like, mineral fibers   9. A disease of the lungs caused by exposure to asbestos fibers   11. Large numbers of workers were first exposed to asbestos when ___________ were built during World War II   13. Abbreviation for forced vital capacity   14. A lung disorder associated with exposure to coal dust (two words)   16. There is a danger of ____________ if the subject breathes as hard as he can into a spirometer during repeated tests   18. The volume units which are most commonly used to measure vital capacity   19. Pollutants which have an affect on the lungs are most often in the form of dust particles or _____________

Down

1. The measurement of lung capacity is   2. Forced Vital __________   3. The number one respiratory disease in the USA   5. Organs which function to remove carbon dioxide from the blood and add oxygen to it   6. Microscopic fibers that cause mesothelioma and asbestosis   8. A deadly cancer of the lining of the chest which has been linked to asbestos exposure   10. A graph that enables you by the aid of a straight edge to read the value of a number when two other numbers are known   12. An instrument used to measure vital capacity   15. A diagnostic procedure which can help identify lung disorders in their early stages   17. The organ which is most likely to be damaged by air pollution



VOCABULARY

Eupnea, asbestos, asbestosis, mesothelioma, emphysema, carcinogen, nomogram, pulmonary, spirometer, spirometry, cancer, black lung, brown lung, hyperventilation, respiratory, vital capacity, tidal air.

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ACKNOWLEDGMENTS

Mrs. Virginia Bloch of the American Lung Association of Virginia was highly cooperative and provided some information for the development of this topic. William Hastings, Jr., a teacher in Chesterfield County, VA developed and tested the materials. Much of the work is based on the 1971 American Biology Teacher article on spirometry by Gerald Llewellyn. The manufacturers of wet spirometers, Hubbard, Propper, and Phipps & Bird as well as Ward's Natural Science Establishment and Carolina Biological Supply Company kindly provided information and photographs. N. Gordon Lohr assisted with some aspects of the topic.

Hazardous Waste Sites And Virginia Geography

MAJOR PURPOSES

- *To increase awareness about the problem of disposing of toxic materials
- *To identify and locate toxic waste sites in Virginia
- *To develop map-study and map-making skills
- *To consider the relationship between the location of hazardous waste sites and environment of the area

RELATED CONCEPTS/UNDERSTANDINGS/QUESTIONS/SKILLS

- *To increase interest in following current events in newspapers and periodicals
- *To gather and organize data
- *To develop awareness of the difficulties which can be encountered in trying to protect the environment

INSTRUCTIONAL APPROACH

Through the use of maps and related activities, students will have an opportunity to become more aware of the problem faced in properly disposing of hazardous wastes. Although the initial activities focus on Virginia and perhaps on one's own community, additional suggested activities will enable students to broaden their perspective to include the United States and even the world. This lesson should be suitable for either a geography class or an earth science class.

OVERVIEW

Many students have little knowledge of the dangers inherent in improper treatment and disposal of hazardous waste materials. Yet, the problem of what to do with these substances is growing.

It is important for students to recognize that the problem is not only real but immediate in that it is faced by their state and localities. In short, they should not think of it as someone elses problem. The activities in this lesson are intended to create this awareness.

Students, for instance, will discover the locations of the following four hazardous waste sites in Virginia included on the Environmental Protection Agency's original National Priorities List: Chisman Creek in York County, Matthews Electroplating in Roanoke County, Saltville waste disposal ponds at Saltville, and U.S. Titanium in the Piney and Tye Rivers in Nelson County. (Note: This list is periodically updated and thus subject to change.)

In addition, the investigation can be expanded to include other sites such as those listed in Appendix II of this lesson. Students should be aware that there are more than two hundred additional sites under investigation by the Virginia Division of Solid and Hazardous Waste Management.

With the activities suggested in this project, students will be increasing their awareness of the problem as well as their geographic skills and understandings.

ACTIVITIES

1. Students will be given a folder which will include a desk-sized outline map of Virginia and the following items which can be found in the appropriate appendix at the end of the project: a road map of Virginia (Appendix I), a list of several hazardous waste sites in Virginia (Appendix II), an instruction sheet (Appendix III), and a list of additional activities which may be done as class assignments or for extra credit (Appendix IV). Colored pencils or markers will need to be supplied by the students or the teacher.

2. Before handing out the folder, the class should discuss the problem that modern society faces of properly disposing of hazardous materials. Usually the discussion reveals that students have not thought about the issue, and that they are unaware of any sites. Ask if they think it is important to be aware of such sites. Invariably, the response is in the affirmative.

3. With the problem now established, turn to a large wall map of Virginia (if available) and point out that "As we go through our lesson today, we shall look at the locations of some hazardous waste sites in Virginia to see where they are located and what they are like."

4. Distribute folders to the students and spend a few minutes going through the materials included. Make certain that students understand the directions given on the instruction sheet. As the students work on the assignment, the teacher will need to walk about the room to answer any questions that might arise. Be sure to check to see that the instructions are followed in the order given.

5. The suggested additional activities (Appendix 4) may be used as regular assignments, projects, or extra credit. A choice might be given to students, such as "complete any three of the following assignments". The use of this sheet is left up to the teacher.

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VOCABULARY

Toxic, toxic substances, hazardous wastes, carcinogen, kepone, chromium, mercury, pentaborane, copperas, PCB's, environment, pollutant, legend, fly ash, corrosive, dilemma, acid runoff coordinates, contaminant, nickel, Roanoke County, Hanover County, Nelson County, Waynesboro, Saltville, Winchester, Hampton, South River, James River, Holston River, Piney River Tye River, Yorktown, Hopewell, Shenandoah River, North Anna Station, Surry Station, vanadium, Richmond

ACKNOWLEDGEMENTS

This revised and edited version was orginally developed and evaluated by Willard W. Wilson, Jr., faculty member at Mosby Middle School, Richmond, Virginia. Bette K. Jirran, faculty member at Lindsay Junior High School, Hampton, Virginia, assisted in the editing and evaluation of this topic. Harriett D. White, a faculty member at Indian River Junior High School, Chesapeake, Virginia, also edited and evaluated this topic.

APPENDIX I

Scource for Maps

1. Outline map of Virginia: Most school systems in Virginia should have available desk-sized maps for student use. Check with your department chairperson.
2. Official Highway and Transportation Map of Virginia: Available from the Department of Highways and Transportation, 1221 E. Broad Street, Richmond, VA 23219
3. Virginia map showing Virginia Power service areas: Available from Virginia Power, Community Services, One James Plaza, Richmond, VA 23219. Telephone (804) 771-3041

APPENDIX II

List of Hazardous Sites in Virginia

Chisman Creek in York County

This is a fly ash dump site. Fly ash from Virginia Electric and Power Co. plants was dumped in this area by private haulers. This apparently has caused contamination of the creek and private wells with metals such as vanadium. Presently, the area affected is served by a public water system but research is being done to determine how to stop the movement of the material via water drainage from the area.

Piney and Tye Rivers in Nelson County

Piles of copperas waste was left by the American Cyanamid Co. U.S. Titanium purchased the property in 1976 hoping to revive the mining operation. This acid waste is an iron sulfate compound that is causing repeated fish kills in both the rivers because of rainwater runoff that is acidic.

Holston River at Saltville

The Olin Corporation's chlorine and caustic soda plant used mercury electrodes and they disposed of them into muck ponds. The ponds have leaked into the North Fork of the Holston River causing high levels of mercury in fish. The FDA stopped fish consumption from the river, and now a clean-up has begun for about 80 miles of the river.

Matthews Electroplating Company

This is one of the four original Superfund sites in the State of Virginia and will probably be the first EPA site in the U.S. to be completed. It is located in Roanoke County near the junction of I-81 and Virginia State Route 460. There were several buildings and a disposal area that was a sink hole where chromium and nickel were disposed. The company served as an automobile bumper plating business but is no longer functioning. The contaminants got into the local water table and contaminated 30 wells. The problem of stopping the contaminants from moving in the groundwater has not been solved, but the local residents now are using municipal water and the site has been covered with a clay cap.

Winchester Tire Fire

In late October of 1983 more than 7 million tires on a five-acre farm began to burn. Thousands of gallons of "goop" from the burning tires, and the water and foam used to control the fire were collected in runoff ponds to prevent the materials from going into a tributary of the Potomac River. The tires were being collected by a resident who hoped to find a method to recycle them. Initially the EPA via the Superfund provided $250,000 to control the runoff. There was concern also about air pollution and carcinogens in the smoke. The smoke was visible for miles around, and the fire burned for several months.

Other Geographic Areas

The South River and the South Fork of the Shenandoah River at Waynesboro has mercury contamination from years ago. The South River actually runs into the Shenandoah. These waters were contaminated by the E. I. DuPont Plant in Waynesboro.

The James River at Hopewell and the City of Hopewell are both sites of expelled kepone. Over a period of many years both Allied Chemical and Life Science Products produced and discharged this insecticide into the James River. This resulted in heavy fines against the companies and the closing of the James River to all fishing.

Pentaborane leak at Hanover Industrial Park involved a New Jersey Company that was hired to disposed of several unlabeled gas cylinders. During the process, pentaborane gas escaped causing the death of one man and permanent damage to others as well as possible damage to rescue personnel. The last cylinder was finally exploded at Fort A. P. Hill under the supervision of the U. S. Army.

In Richmond there is a lead smelter plant that has had problems with lead emissions into the air and uptake of lead by workers. This plant recycles lead but is located in a partially residential neighborhood. The recycling aspect is commendable, but the odor and air contamination are objectionable.

At Surry and North Anna there are four nuclear power units and related facilities. Each site is storing spent fuel elements that are highly radioactive. There have been no significant radiation incidents at these two facilities.

In 1983 approximately 4000 gas cylindrs were found stored on a lot in Hampton, Virginia. These were cylinders that contained everything from oxygen and nitrogen to acetylene and methyl bromide. They were purchased from the federal government to be recycled. The fire chief of Hampton eventually provided the backup security and fire support as an EPA contractor removed and disposed of the tanks.

There are several small sites where PCB's have been spilled. Generally these are from transformers or related to transformer disposal.

Other Waste Sites in Virginia

At this writing there are 276 sites in Virginia being investigated by the Bureau of Hazardous Waste Management. The seriousness of each site is yet to be determined, but most of these sites are problems and will have to be dealt with in the future. From the places on this list, it is possible to locate many of them in a certain county. Others lack a specific address, but details on such specifics and list itself can be obtained by calling or writing the Virginia Department of Health, Madison Building, Richmond, VA 23219.

PLEASE NOTE

Appendix III starts at the top of the next page so that it can be reproduced easily on a copy machine and then distributed to the class. To eliminate Appendix IV from the reproduction, merely tape a white cover sheet over that section before making the copy.

APPENDIX III

Sample Student Instruction Sheet

I. General Directions

A. Check your folder for the following items:
   1. Virginia Road Map
   2. Student Outline
   3. Instruction Sheet
   4. List of toxic waste sites in Virginia
   5. A list of additional activities

B. Put your name on each sheet

C. Double check everything before you mark your maps

D. Write very small and neat

E. Raise your hand if you need help

F. Do your own work

II. Virginia Road Map Exercise

A. On the road map circle the following cities
   1. Saltville
   2. Waynesboro
   3. Winchester
   4. Hampton
   5. Roanoke
   6. Hopewell

B. On the road map outline the following counties
   1. York County
   2. Nelson County
   3. Hanover County

C. On the road map mark the following rivers
   1. Holston River
   2. James River
   3. Piney River
   4. Tye River
   5. South River
   6. South Fork of the Shenandoah

D. On your own paper list the cities and counties in II, A and B.
   1. Beside each city and county of II, A and B, give the coordinates where they can be found. Put the coordinates in parentheses.
   2. Use the legend on the road map and give the approximate populations of the six cities in II, A.

III. Virginia Outline Map Exercises

A. Use your road map to help you mark the cities and counties listed in II, A and B, on your Virginia outline map.

B. Use your road map to help you mark the rivers listed in II, C, on your Virginia outline map.

C. In the northeast corner of the Virginia outline map, list the following toxic substances or hazardous materials:

1. Mercury
2. Tire Goop (Tire Fire)
3. Kepone
4. Pentaborane
5. Gas Cylinders
6. Fly Ash
7. Copperas
8. Chromium and Nickel

D. Beside each toxic substance (listed in Part C) make up a symbol to be used on your Virginia outline map.

E. Put these symbols beside the appropriate city or county on your Virginia outline map.

F. Use your road map to help you mark the Interstate Highways on your Virginia outline map.

APPENDIX IV

Additional Satellite Activities

1. To comment on various aspects of the sites listed on the maps invite a guest speaker from the Regional EPA Office, the State Water Control Board, the State Bureau of Solid and Hazardous Waste Management, the Sierra Club, and/or local industry.

2. Choose one of the hazardous waste sites from the list for further study. Write a letter to the Regional EPA Office, the State Water Control Board, the State Health Department, a representative of the city or county government to gain more information about that site.

3. Conduct an interview either in person or by phone with a representative of a business dealing with hazardous wastes such as a service station or an oil company. Ask what means are used in transporting such materials. What safety measures are used?

4. Make a survey and then locate on a local map which service stations in your city or county recycle oil.

5. Plan a bulletin board display using newspaper and magazine articles relating to sites of hazardous wastes materials in your state, the nation, or world.

6. Prepare a salt map of Virginia showing the four Superfund sites and at least ten additional sites of hazardous waste. (See Appendix 5 for instructions)

APPENDIX V

Salt Map Construction

The outline of the State is drawn on a board about 18 by 24 inches. The major waterways and mountains should be added. Students should determine the location of the sites to be marked as well as how they intend to identify the locations.

Next, make a thick paste of salt, flour, water, and coloring. Colors would be green for land and blue for water. Boundaries can be emphasized using other colors.

The basic recipe for this mix is 2 cups of all-purpose flour, 1 cup of table salt and 1 cup of water. Add coloring to give the desired shade. Combine flour and salt in a large flat-bottomed bowl, and mix well with a spoon. Next add water, a little at a time, mixing as you pour to form a ball. Additional water may be needed depending on humidity. Take care not to add too much so the dough becomes sticky. Knead for 7 to 10 minutes until the dough has a smooth, yet firm consistency. Place dough in a plastic bag to prevent drying. Remember, do not use self-rising flour. Science classes should convert the above measures into metric values and utilize metric measuring equipment.

For convenience, dough can also be made up ahead of time and stored in a plastic bag in the refrigerator for up to five days. If the dough becomes dried out, simply pat on a lttle more water and knead it back to the original consistency. If the dough becomes sticky, just add more flour.

Tooth picks and a butter knife may be helpful. Always add flour to the hands and work surfaces to keep dough from sticking. Do not add flour to the board. To join any two pieces of dough together, simply moisten both edges with tap water and press together. The water acts as a glue and keeps the dough from separating during the baking or air drying process.

You can place the different colored dough in the appropriate areas and also, if you wish, you can use letters or numbers to designate the sites of interest. It is suggested that you use macaroni letters and numbers of various sizes.

For air drying, allow the map to sit for at least 48 hours until it has a rock-like hardness and is white and limestone in appearance if it is uncolored. After it has dried completely, a covering of shellac is added to prevent deterioration. Locations may still be added to the map with paint or permanent markers. A key or code system for the locations may also be added via macaroni letters, marking pens or on a typed list on the front or back. If it is on the back of the map, then the map tends to function as a teaching aid but care must be taken so the board and dough do not separate.

NOTES

Transporting Hazardous Materials: A Serious Business

MAJOR PURPOSES

*To become aware and identify hazardous materials transported over the highways
*To recognize safety placards used by vehicles which carry hazardous materials
*To describe the most important factors of the manifest system - cradle to grave

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS

*To define the term "Hazardous Material" and Hazardous Waste"
*To describe groups of hazardous materials
*To recognize some of the safety factors involved in transportation of hazardous materials
*To discuss original warning placards
*To encourage the discovery of universal color codes as used in the transportation of solids, liquids and gasses

INSTRUCTIONAL APPROACH

This lesson is suitable for life science, general science, physical science or earth science classes. It can also be used to supplement many other science or social science classes in the middle or high school. The teacher should provide booklets, articles and clippings of actual highway accidents involving transportation of hazardous materials.

Students will be asked to record on a chart any safety placards they observe on the vehicles transporting hazardous materials. A classroom bulletin board would be an effective way to motivate the class. The State Police, fire bureau, safety supply company or Office of Emergency Services could all contribute by providing visiting speakers and slides of accidents. A local television station may have file tapes of transportation accidents which it would lend or allow a copy to be used while you are teaching this topic.

The suggested activity, Searching and Recording Placards, will show students the many ways hazardous materials are transported. It should provide them a better understanding of the safety precautions involved in the transportation of hazardous materials by packers, handlers, loaders and motor carriers. A time limit of one week should provide an adequate sample for their survey of placards found on transporting vehicles. After the survey is completed, the class will tally the results. These results may be placed on a bulletin board or graph boards.

OVERVIEW/BACKGROUND

Hazardous wastes may be transported as solids, liquids or sludge. Routinely trucks are transporting these materials over our roads, highways and interstate transportation system. For the most part the safety signs or placards go unnoticed by the majority of citizens.

We need to become more aware of the dangers involved with the transportation of these materials. This transportation is regulated by the Department of Transportation (DOT). They have classified the hazardous materials as to their nature and the threat which they pose to the public.

Hazardous waste is normally a solid material that has one of the following characteristics: ignitability, corrosivity, reactivity, toxicity. As a waste it is normally of little economic value and cannot be readily recycled. Hazardous waste transport must be accomplished safely from one point to another. The sender, carrier and receiver of such material must also prepare, carry and receive the accompanying paper work describing the material being transported. This written information is called the manifest. It provides a historical record and details of the transportation and relocation of the material moved.

Safety placards (signs) are designed and required to appear on the outside of the vehicles used to alert the public of the cargo's contents. Labels must also be placed on all material in the shipment to alert handlers of the dangers involved.

The DOT has published a book, Emergency Response Guide Book-Hazardous Materials to provide safety regulations that individuals must used while handling the hazardous materials. The safety placards used by carriers are displayed in this book, along with the proper procedures to be taken should an accident occurring during the transport of these materials. Copies of this book will be invaluable to the students in the course of their study of hazardous waste transportation. It is inexpensive ($3.00) and can be ordered from J. J. Keller & Associates, Inc., 145 W. Wisconsin Av., Neenah, WI 549056 (1-800-558-5011).

ACTIVITY

Searching and Recording Placards

The students should locate visually and document placards that indicate the transporting of hazardous or toxic materials using the sketched diagrams in Figure 1 and the DOT Emergency Response Guidebook. A survey may be made while traveling, from a safe observation point away from the traffic on a major highway or interstate road or by observing passing trains from a distance.

SAMPLE TABLE

PLACARD NAME	DOT #	COMMON NAME OF CHEMICAL	TYPE OF TRANSPORTER	OBSERVATION LOCATION

ADDITIONAL ACTIVITIES

Students may make a collection of newspaper articles dealing with hazardous materials. This collection should deal with recent events and current information on the transportation of hazardous materials.

Classes may create placards to be used for the international transport of hazardous materials from one country to another.

Guest speakers would further stimulate the interest in the careful use and handling of dangerous materials.

Students may play a safety placard game in the format of a spelling bee where they identify the placards.

Students may add the correct color, label and give chemical identification numbers to the placards sketched in Figure 1.

VOCABULARY

Hazardous, hazardous waste, manifest, placard, toxic, solid, liquid, sludge, cradle-to-grave.

REFERENCES

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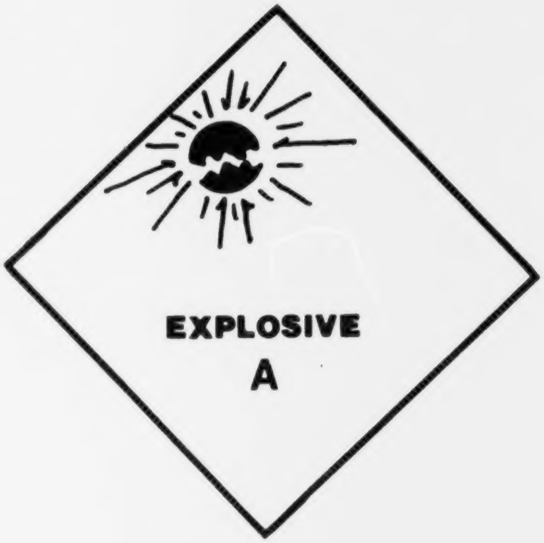
Emergency Response Guidebook - Hazardous Materials Incidents, DOT-P-5800.3, 1984, U.S. Department of Transportation, Washington, D.C. 20590 (Can be ordered for about $3.00 each from J. J. Keller & Associates, Inc., 145 W. Wisconsin Av., Neenah, WI 54956, 1-800-558-5011).

Transportation of Hazardous Waste, 1981, National Solid Waste Management Association, Suite 930, 1120 Connecticut Avenue, Washington, D.C. 20036.

ACKNOWLEDGMENTS

This edited version was originally developed and evaluated by the following faculty members from Virginia schools: Elaine Woodard, Powhatan County Schools, Betty T. Hall, Henrico County Schools and Martha A. Knight, Hopewell City Schools.

Figure 1. Placards For Use in the Searching or Other Activities.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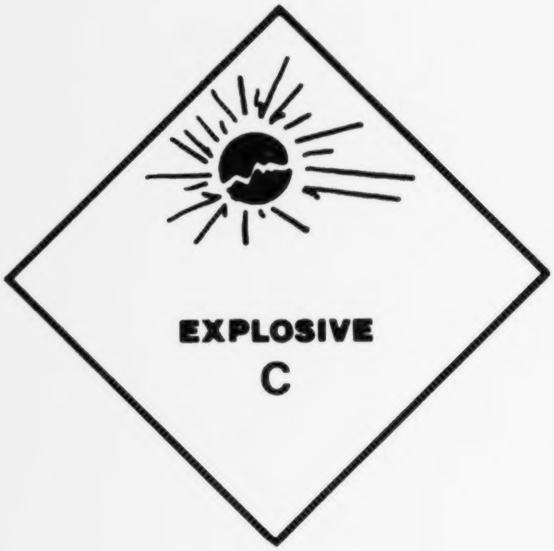
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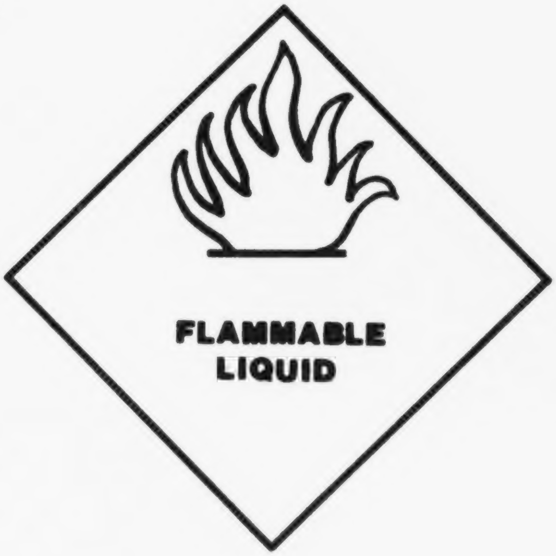
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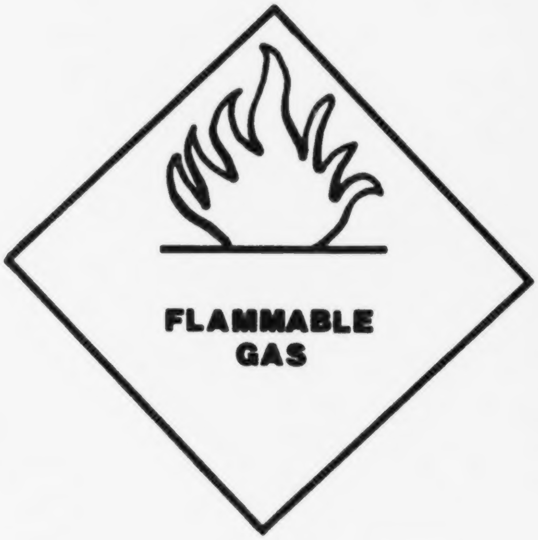
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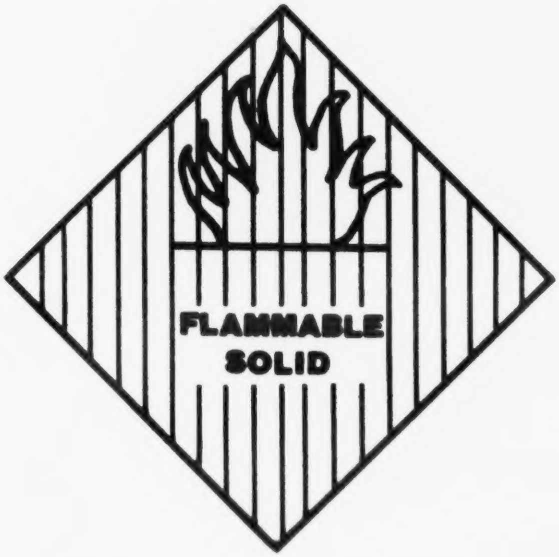
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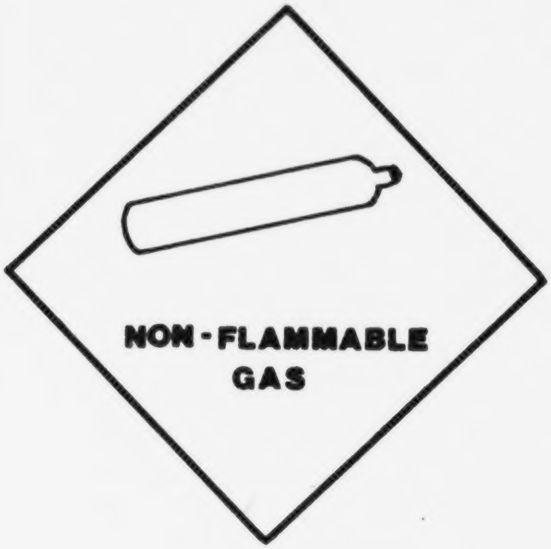
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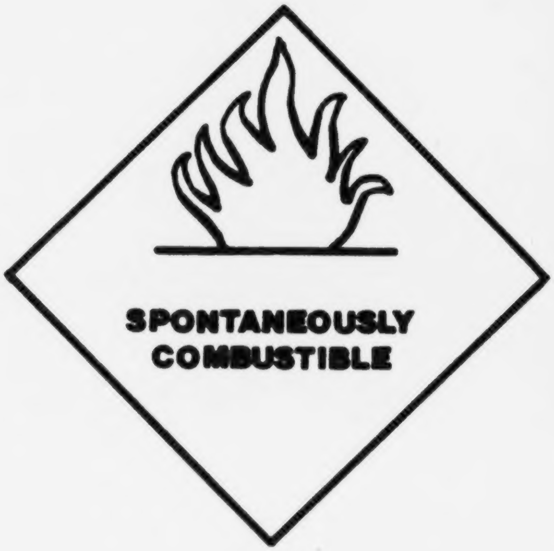
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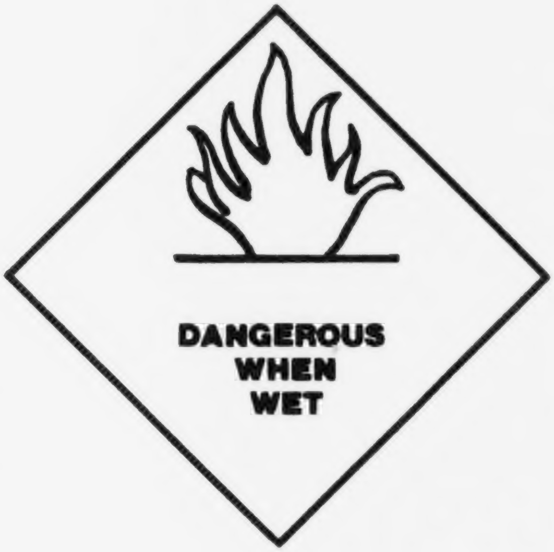
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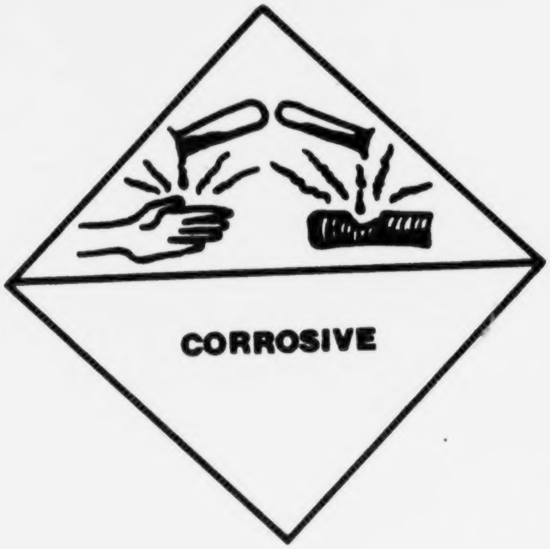
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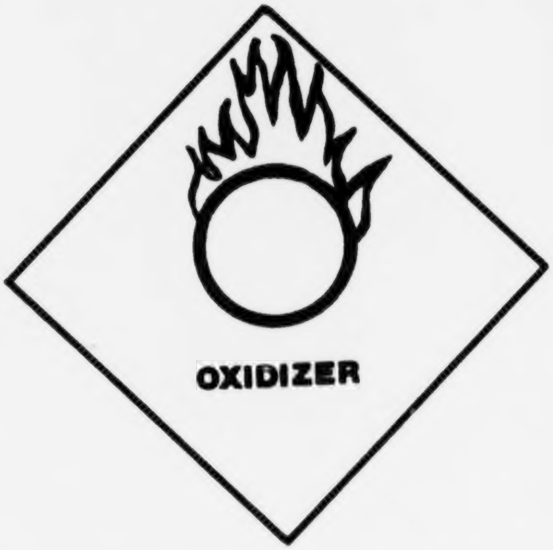
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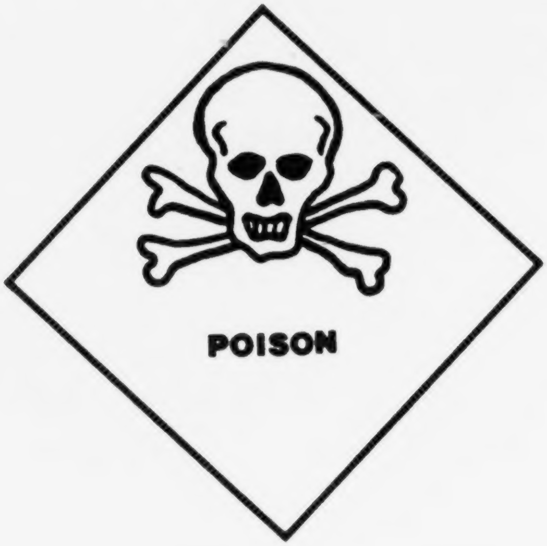
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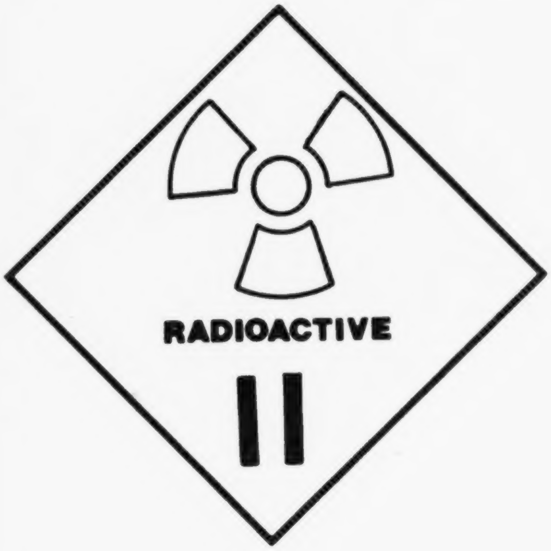
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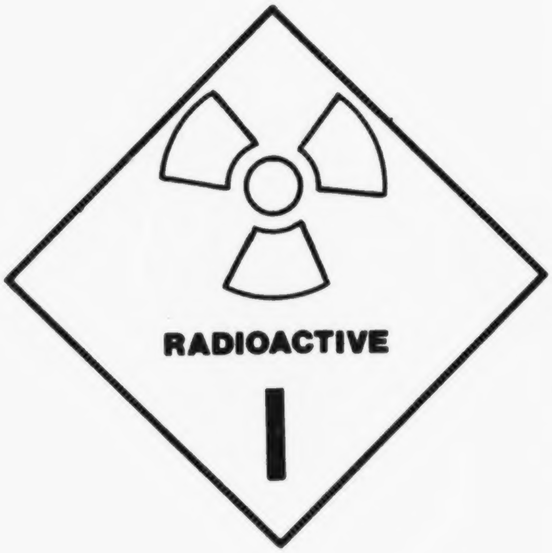
RADIOACTIVE
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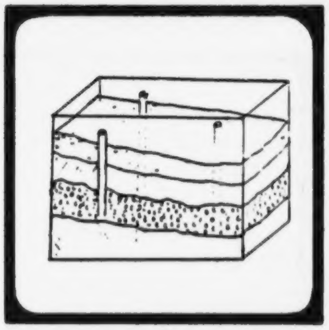
A Demonstration Of Groundwater Contamination In A Hazardous Waste Site Model



MAJOR PURPOSES

*To provide an understanding of the theory, assets, and liabilities of the secured landfill method of waste disposal
*To illustrate the construction details and monitoring of a secured landfill as compared to a non-secured landfill

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS/QUESTIONS

*To illustrate contamination of groundwater
*To construct and test for groundwater contamination using a model landfill
*To visualize via the experimental and working model how ground strata absorption and contamination can occur
*To develop skills in model construction and techniques for data collection

INSTRUCTIONAL APPROACH

This exercise may be used as a major project on contamination of groundwater by chemical pollution or as an exercise on the study of ground strata. This is a long-term project requiring about four weeks before contamination can be observed in the shallow or deep monitoring wells of the model. The time-delay should encourage the students to be aware of how slowly such contamination could occur in a natural situation. This project should work nicely as a class exercise with students making the model as a team, collecting the data, and making daily records. The class may have several teams or the teacher could use it as a demonstration with the students collecting the data. The chemicals should be handled carefully, respected for their chemical characteristics, and disposed of properly.

OVERVIEW/BACKGROUND

Hazardous wastes can result from mining, farming or industrial manufacturing processes. These waste products come from manufacturing of many vital products, yet these wastes can contaminate the groundwater if improper disposal occurs. It is the purpose of this lesson to provide some understanding as to how toxic pollution can occur from disposal sites.

Pollution has been defined as the addition of foreign matter to the natural environment to a degree which is not supported by nature. All pollutants are not toxic. Toxic substance or hazardous waste pollution affects negatively the quantity and quality of living systems in the environment. A body of water is a dynamic system which constantly absorbs a range of solids, liquids, and gases, both those that are natural and those that are man-made.

There is a serious concern throughout the country and world about the purity of water supplies for both domestic and industrial use. It is virtually impossible to find any natural body of water that has not been affected either through the addition of man-made pollutants or through the manifestation of man's activities. There is an increasing demand for clean or unpolluted fresh water for a variety of purposes. Very often the water is of such low quality that it is not acceptable to the consumer, e.g., use for drinking water for airplane passengers. Underground water is being contaminated more and more. In some communities the leachate from a "mid-night" created toxic waste site is moving through the soil at more than one foot per day (R. Tunley, "Time Bomb In Our Tap Water," Readers Digest, 126:90-96, January, 1985).

Natural waters teem with living organisms which can affect the ecosystem of a given body of water. All the substances, both living and non-living, can flow, disperse, and interact chemically and physically before they reach a permanent settling point such as the ocean or a receptor such as a fish or crustacean. During the journey from source (above ground, leachate, underground and above ground again) to receptor, the substances may acquire a variety of chemical and physical forms. An example would be the mercury leaching into the Holston River in Virginia, and its change to methyl mercury. On the other hand, kepone, an insecticide, discharged into the James River, also in Virginia, is slow to break down but is continually becoming part of the sediment and then being washed out again on a seasonal basis.

Water is considered polluted, by one or more substances, if it is not suitable for its intended utilization such as agricultural and industrial supply, recreation, propagation of fish and wildlife, and domestic water supply. Scientists consider water pollution as the detection of specific undesirable agents and the depletion of oxygen with all of its consequences, while the general public takes a broader perspective.

What is groundwater? It is precipitation that has percolated down through porous earth and collected in sponge-like layers of rock, sand, and gravel. These saturated formations are called aquifers, and they lie under almost every part of our country. They may be only a few inches to several miles deep in the ground. Groundwater may move very slowly and not cleanse itself as was previously thought.

Contamination of groundwater by toxic chemicals has become a major problem only being recognized in the 1980's. Irresponsible disposals, accidental dumping, poorly constructed but approved sites (Love Canal), and the recent influx of the criminal element seeking high profits from mid-night dumping are becoming serious problems to our water supply. Consider reading "Toxic Waste: Organized Crime Moves In," from Readers Digest, 125:73-78 (July), 1984. A landfill that begins to leak (leach) will present a serious hazard to our groundwater and to our health. This is especially true if well water is used by the nearby residents. A hazardous waste landfill is a burial site for unusable and dangerous chemical wastes but without any consideration for long-term protection of human health and the environment. But a secure hazardous waste landfill is much more than just a burial ground. It is a highly developed waste management method that uses proven procedures and techniques to provide total containment of hazardous materials, thereby protecting surface and groundwater from contamination.

The design concept of a secured landfill is quite different from that of a land disposal facility for non-hazardous wastes, the conventional sanitary landfill. When hazardous wastes are disposed, the objective is to contain them completely for as long as they remain hazardous. A non-hazardous waste landfill is designed to control discharges of contaminants so that they do not cause or contribute to environmental contamination of groundwater.

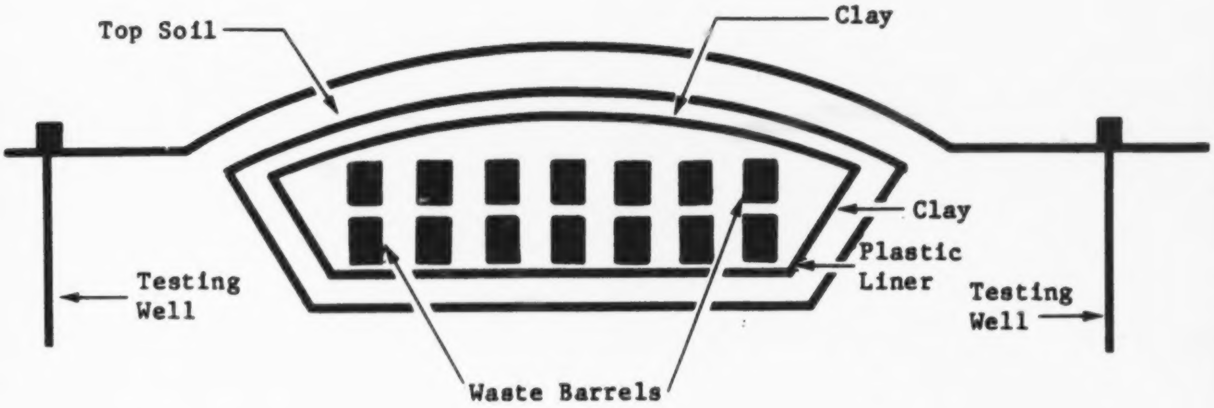
In essence, a secure landfill is a containment "envelope" typically made from thick, impermeable clay soils and/or synthetic materials. It is usually constructed in cells to segregate and isolate hazardous materials of different types. Clay, plastic liners, or other low permeable materials are used to assure that the hazardous waste materials placed there never escape into the air, surface waters or groundwater. Wells are drilled nearby for continual monitoring of groundwater for leachate from the site.

A secure landfill is a safe and approved method for disposing of hazardous waste materials which cannot be treated by other modern methods now available. Some wastes may be too contaminated with heavy metals and other non-combustible materials to incinerate, too thick to inject into deep wells, too difficult or impossible to degrade chemically for harmless discharge into the air or surface waters, or not suitable to process for recovery of reusable materials or energy. A secure landfill is a method available for disposal of contaminated resides from the recycling, resources recover, and incineration processes in which "something is always left over." The secured landfill-method is required and approved by the EPA but there are few approved sites available, and, of course, nobody wants such a site in their own backyard.

The "New RCRA" (Resource Conservation Recovery Act), as approved by the 1984 Congress and under the direction of the EPA, will strengthen and limit some of the current disposal procedures.

Included is a cross-section of a secured landfill that may be made into a teaching and testing transparency (Figure 1). We recommend the use of the third in a series of publications by the Institute for Chemical Waste Management, National Solid Wastes Management Association, Suite 930, 1120 Connecticut Avenue, N.W., Washington, DC, 20036. Additional background information may be used from publication 4 and 5. Why not consider the films relating to this topic such as "In Our Own Backyards: The First Love Canal" or "Hazardous Waste Options." These and others are included in the A-V Resources.

Figure 1. Cross-Sectional Sketch of a Secured Hazardous Waste Landfill.


Top Soil
Clay
Clay
Plastic Liner
Testing Well
Testing Well
Waste Barrels

MODEL LANDFILL CONSTRUCTION & TESTING ACTIVITY

Construct a model of a non-secured landfill in a small transparent box consisting of clay, a water saturated sponge, and sand (Figure 2). Use large glass tubing to construct several shallow and deep monitoring wells. Measure the time required for chemical contamination in the shallow and deep monitoring wells. Look for evidence of contamination and record results each day. Sample the wells with a long, "pulled" medicine dropper and test the contents of the sample with pH or litmus paper. Introduce each day into the center of the layer of sand a 10 ml sample of vinegar. Water colored with food coloring can be readily substituted and is safer and has less odor than the vinegar, but it will not cause the color change on the pH or litmus paper.

Students may want to construct their own landfills, secured or non-secured in plastic shoe boxes and use the box cover to retard evaporation. Straws of various sizes could substitute for the glass tube wells and the medicine dropper-sampler. Colored water should be added daily.

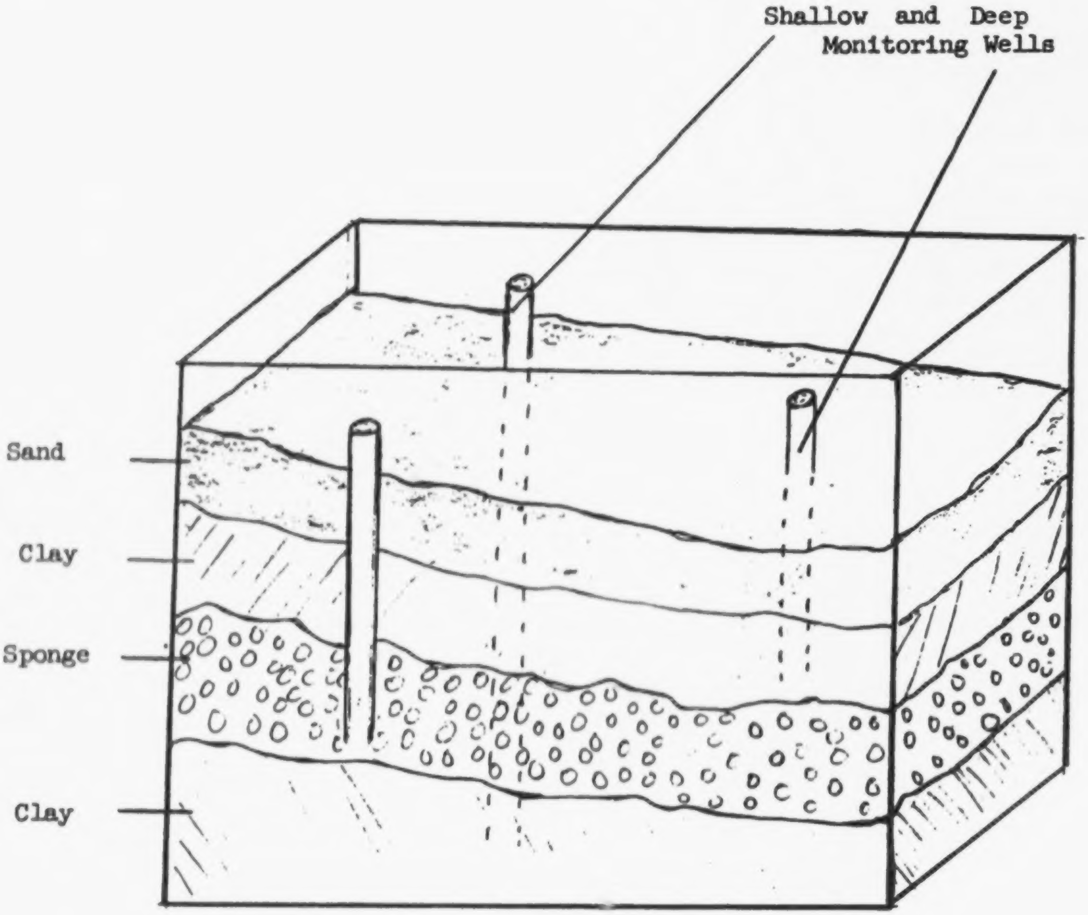
Materials needed for the above experiment include a transparent container such as a molded-glass aquarium, a plastic shoe box, an animal cage bottom, a gallon jar or a small aquarium. A tight-fitting clear plastic or glass cover is required. In addition clay, sand, sponge or foam padding, glass tubing, colored chemicals or vinegar, long-stemmed medicine droppers, and litmus or pH papers are needed. We caution you about the substitution of other acids or bases for the vinegar or colored water. Even with the vinegar and water, be sure to use goggles and an apron when the liquid is handled.

The following are some technical suggestions for this activity. The glass tubing for the wells should be large enough to allow a medicine dropper to be inserted to remove samples of groundwater. The medicine dropper can be made from long pieces of small glass tubing by heating the glass and pulling it into a narrow opening. As reported above a small straw could be substituted. Scatter the deep and shallow wells at random throughout the layers of clay, sand, and sponge. These wells should be placed into the sponge layer before the clay layer and upper sand layers are included. A secured landfill is constructed using a plastic liner, and it could serve as a control in the experiment, or it could have a few pre-planned punctures to serve as leaks. Introduce the colored water, dye, or vinegar daily on the top of the landfill to simulate rainfall and runoff water as it enters the soil and ground. Place a glass cover over the top of the model to prevent outside contamination and evaporation of the water and chemicals. Contamination will be evident in about 2-3 weeks depending upon how tightly packed you make the upper layers of clay and sand. Remember that the colored water will seep down between the container wall and the materials if it is not applied to the center of the model.

FOLLOW UP ACTIVITIES

Discuss the relationship of time required to contaminate the shallow and deep wells with the contaminating chemicals and their chemical and physical characteristics.

Figure 2. Model and Components for Student Landfill Construction Project.


Shallow and Deep
Monitoring Wells
Sand
Clay
Sponge
Clay

Discuss the time amount of time needed for the secured landfills to became contaminated.

Discuss why some substances will allow rapid penetration and other soil-materials will not.

Have the student identify hazardous waste disposal sites and landfills in your area. Arrange for them to interview the management of such a site or have an EPA official or State Department of Health official visit your class. Consider having the State Water Control Board Enforcement Officer speak to your class.

Compare the function, effectiveness, and cost of a secured landfill to a non-secured landfill.

Develop a contest where students construct landfills of natural materials but without the liner. Then see which student's model is the most secured. Give prizes for the best landfill.

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Brown, M. "Toxic Waste: Organized Crime Moves In." Readers Digest, 125:73-78 (July), 1984.

Hazardous Waste and Landfills. Publication numbers 3, 4, and 5 from the Institute for Chemical Waste Management. National Solid Waste Management Association, Suite 930, 1120 Connecticut Avenue, N.W., Washington, DC 20036

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Farb, D. G. Upgrading Hazardous Waste Disposal Sites: Remedial Approaches. Environmental Publication, SW-677, 1978, EPA, Washington, DC 20056.

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Tunley, R. "Time Bomb in Our Tap Water!" Readers Digest, 126:90-96 (January), 1985.

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VOCABULARY

Groundwater, surface water, landfill, secured landfill, cells, plastic liner, clay, sand, leachate, monitoring wells, pollutant, mid-night dumper.

ACKNOWLEDGMENT

This edited lesson was originally prepared, tested, and evaluated by Charles R. Stephenson, a faculty member at George Washington High School, Danville, VA.

The Option Of Waste Exchanges

MAJOR PURPOSES

*To provide an example of an economically and environmentally sound option to waste problems
*To explain the concept of waste exchanges

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS/QUESTIONS

*To provide an exercise in reading for information
*To develop research techniques

INSTRUCTIONAL APPROACH

This project uses transparencies (provided), worksheets (provided), and an article from Ranger Rick magazine (provided). Teachers should find the activities especially suitable for students of low reading ability. An extension of this project could involve developing certain research skills.

OVERVIEW

Students who become concerned about the problem of hazardous wastes are usually anxious to find out what can be or is being done about the situation. Waste Exchanges provide an example of an innovative action for dealing with wastes that has proven economically and environmentally sound. Of course, it is not the total answer to the problem but is an important option.

The exchanges allow potential buyers and sellers of waste products to contact each other while maintaining confidentiality and protection of trade secrets. By the creation of waste exchanges, the volume of hazardous waste produced can be reduced through recycling and reuse in other industrial processes.

BACKGROUND INFORMATION

The VWE (Virginia Waste Exchange) published in December, 1982, its first catalog of wastes that could be bought/sold. The catalog is to be published two times per year. The VWE was initiated by the Va. Solid Waste Commission and is now operated by the Va. Chamber of Commerce. Future plans include merging Virginian's Exchange into one that will serve a region consisting of a number of states.

The idea of waste exchanges is not a new one, having originated in Europe in the early 1970's. There are two types of exchanges. One is a waste information exchange or information clearinghouse (which Virginia operates). The other is a waste material exchange (whereby the organization physically, economically, and legally takes possession of the waste and then sells it).

The need for waste exchanges becomes apparent as one considers the large amounts of waste generated by today's technological society. Disposal is a problem due to the large quantities, potential hazards, and expense. Through recycling and reuse of waste materials as a raw material for another industrial process, the amount of waste that that has to be disposed of is reduced.

The waste exchanges save disposal costs, conserve natural resources, and encourage the reuse of energy-rich waste materials such as waste oil. Additionally, a waste exchange benefits small companies because they don't need to spend time and money researching how to use their waste, instead, they can sell it. Finally, the waste exchange provides excellent public relations benefits to a company.

TRANSPARENCY EXPLANATION

The transparency gives an example of how a buyer (Bonnie Bunson) and seller (Mrs. Gobble) could benefit from the waste exchange.

First, Mrs. Gobble buys a listing in the catalog telling the waste she has to sell, the amount generated, type of storage container, and location of site (the general area of the state in which she is located). The Virginia Waste Exchange (VWE) gives her a number code under which she lists her information. By listing under a number only, Mrs. Gobble's confidentiality is protected.

Bonnie Bunson can buy a subscription to the bi-annual catalog (if she is not a lister also; listers receive the catalog free). When she sees a listing that interests her (i.e., gukum), she contacts the VWE, who will then forward her name to Mrs. Gobble. If Mrs. Gobble wants to, she may call Bonnie and a deal can be set up.

In order to speed up the process, Mrs. Gobble may choose to list non-confidentially. In that case, when Bonnie calls VWE, they can give her Mrs. Gobble's number (in addition to forwarding Bonnie's number to Mrs. Gobble) so that Bonnie may contact Mrs. Gobble herself.

ACTIVITIES

1. Hand out copies of "Gukum" and of the worksheet to each student. Allow time for students to read and answer questions. Go over answers to questions with the class.

2. Read together the footnote at the end of the story and products that can be used in other industries.

3. Introduce the Waste Exchange concept. Use transparency of Mrs. Gobble and Bonnie to explain how an exchange might occur. (See preceding transparency explanation)

4. Give lesson on Waste Exchange using background information provided.

5. Show the transparency of WASTE EXCHANGE logo and discuss what it symbolizes. (Students may offer several ideas of what they feel it symbolizes; accept any ideas they can support.)

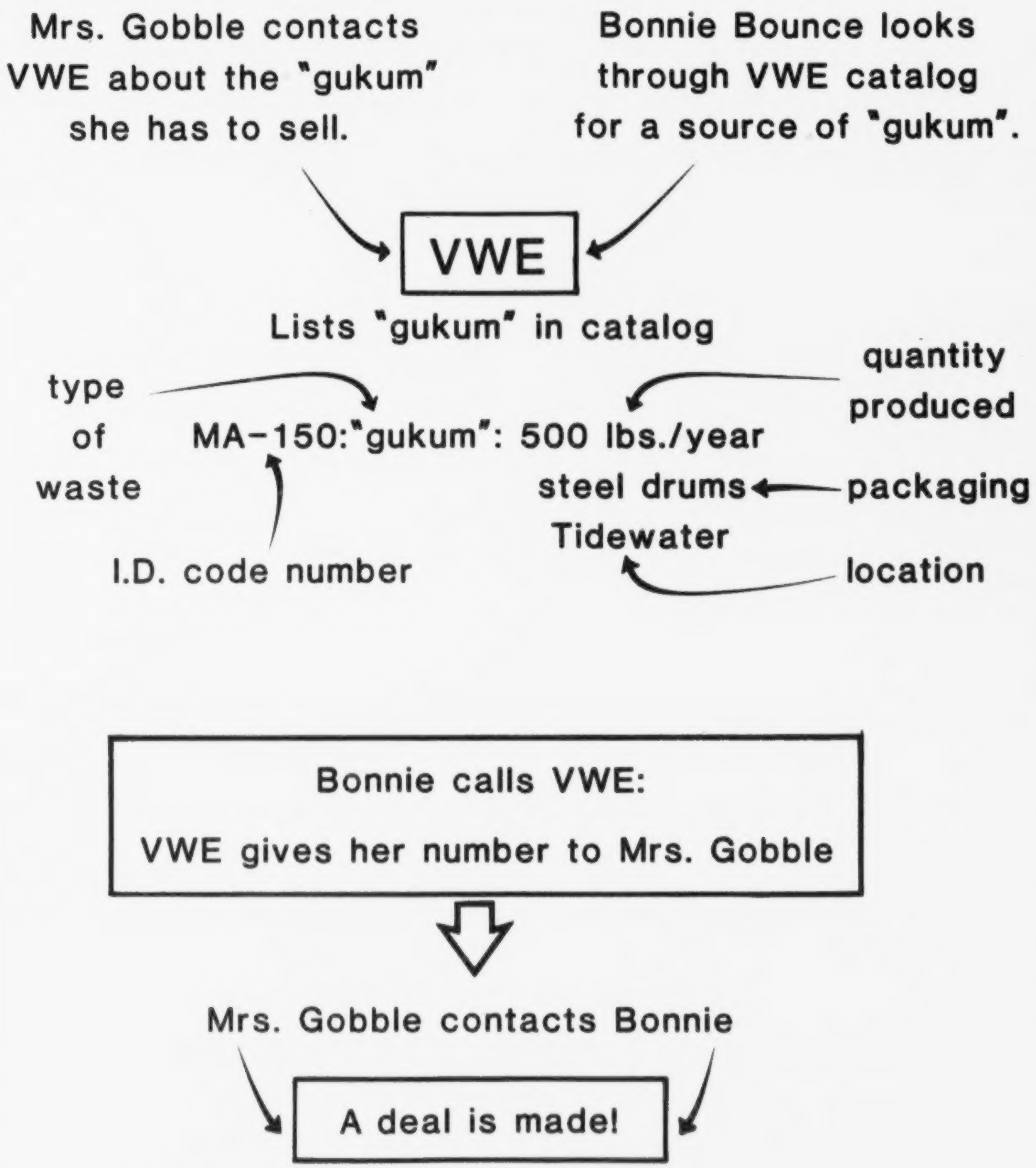
EXTENSIONS

1. Research local companies and find out if any of their wastes are being turned into useful products.

2. Examine a copy of the VWE catalog to see the types of wastes currently being offered for exchange. Try to find out what types of companies might be able to use the wastes.

SOURCE OF CURRENT INFORMATION:

Va. Chamber of Commerce
611 E. Franklin St.
Richmond, Va. 23219



Mrs. Gobble contacts VWE about the "gukum" she has to sell.

Bonnie Bounce looks through VWE catalog for a source of "gukum".

VWE

Lists "gukum" in catalog

MA-150:"gukum": 500 lbs./year

steel drums

Tidewater

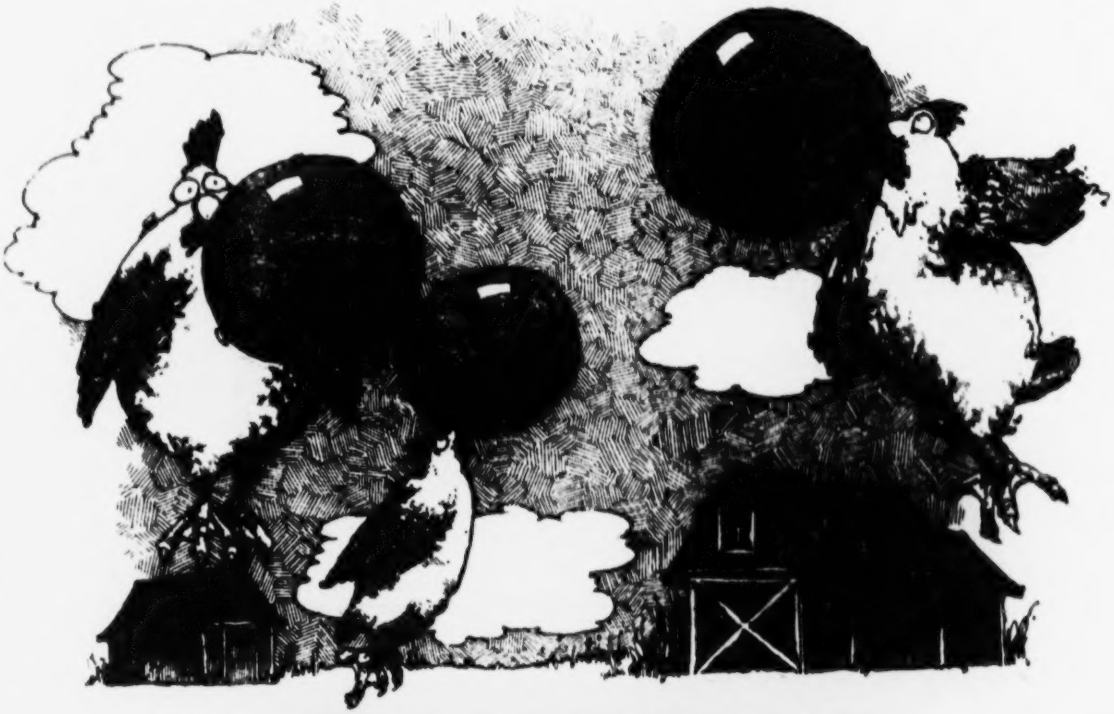
type of waste
I.D. code number
quantity produced
packaging
location

Bonnie calls VWE:

VWE gives her number to Mrs. Gobble

Mrs. Gobble contacts Bonnie

A deal is made!



GUKUM

by Ann Coburn

Greta Gobble whistled merrily through her rosy lips. She was always happy as she inspected the busy machines in her bubble gum factory. After all, she was a rich woman. Kids all over the country were buying her Gobble Bubble Gum.

But not everyone was happy with the factory. And when Ms. Gobble finished her inspection and returned to her office, she found out why. Mr. Epa, a man from the U.S. Government, was there waiting for her.

"You see, Ms. Gobble," Mr. Epa explained, "we've been getting lots of complaints."

"What kind of complaints?" Ms. Gobble asked.

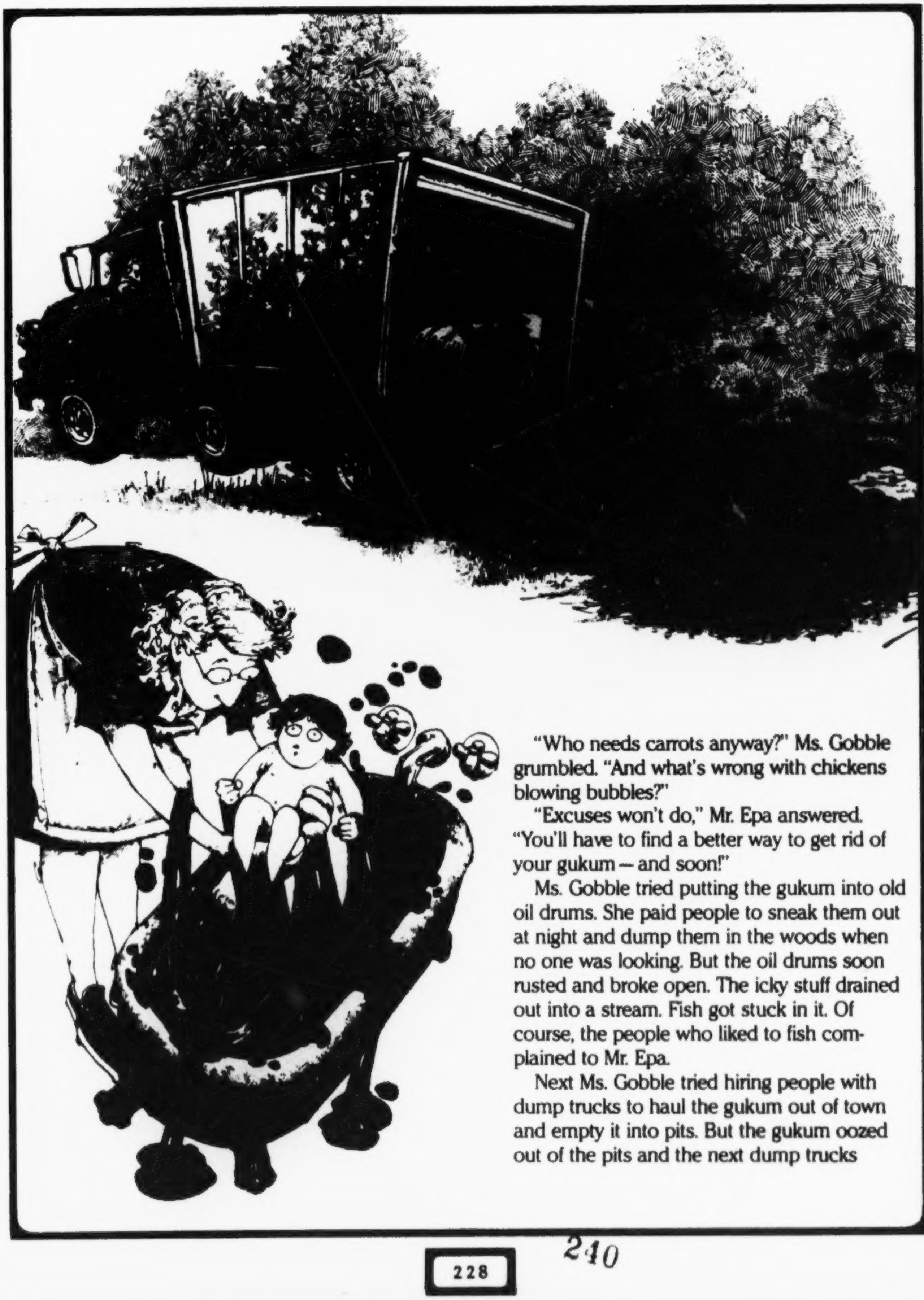
"Well, people don't like the way you handle your factory's waste. You've been dumping it in the river. And that's where people in this town get their water."

"You mean our *gukum*. That waste doesn't cause any real trouble. I've never . . ." Ms. Gobble began.

"That's not what I've been hearing," Mr. Epa interrupted. "One woman called to say that gukum is coming out of the faucets at her house. Her little boy even got stuck to the tub when he was taking a bath!"

"So — what's the problem?" Ms. Gobble laughed. "Kids hate to take baths anyway."

"Other people," Mr. Epa continued, "are upset too. One woman told me that she watered her garden every day last week. Yesterday she tried to pull up her carrots. But they were stuck in the ground — with gukum! And a farmer says the gukum in the water his chickens drink is bad for them. All his hens blow bubbles when they cackle."



"Who needs carrots anyway?" Ms. Gobble grumbled. "And what's wrong with chickens blowing bubbles?"

"Excuses won't do," Mr. Epa answered. "You'll have to find a better way to get rid of your gukum — and soon!"

Ms. Gobble tried putting the gukum into old oil drums. She paid people to sneak them out at night and dump them in the woods when no one was looking. But the oil drums soon rusted and broke open. The icky stuff drained out into a stream. Fish got stuck in it. Of course, the people who liked to fish complained to Mr. Epa.

Next Ms. Gobble tried hiring people with dump trucks to haul the gukum out of town and empty it into pits. But the gukum oozed out of the pits and the next dump trucks coming in got stuck in it. The owners of the trucks refused to haul any more gukum.

Then Ms. Gobble tried something else. She had the gukum loaded into tank cars on a train. But the train was sidetracked for several days in the hot sun. The gukum got hotter and hotter. As it did, it expanded, or got bigger. Finally one of the cars exploded! Then another one. And another one. Gukum spread all over the town. Now *everyone* was mad!

Mr. Epa said, "I'm sorry, but your factory will have to close until you find a safe way to dispose of your waste."

Ms. Gobble was desperate.

But while all this was going on, something else had been happening. A smart scientist named Bonnie Bunsen lived in this town. While she was working in her basement laboratory one day, she noticed some of the gukum dripping from her faucet.

"What in the world is this?" Bonnie asked.

She took a drop of the goo and looked at it under her microscope. *Surely,* she thought, *this stuff must be good for something. And wouldn't it be great if I could find a use for it?*

Bonnie tried mixing many different chemicals with the gukum. The scientist worked for weeks on the project. Finally one day she was so tired she fell asleep at her lab desk.

When Bonnie woke up, she saw that the gukum mixture from one of her containers had spilled onto the floor. It was everywhere, even on her shoes. Bonnie pulled her shoes free, but some of the sticky stuff clung to them. She started to walk up the stairs. But she didn't walk. She bounced.

"Look," Bonnie shouted to her husband as she bounded across the floor of the kitchen. "I can hop better than a rabbit—or a kangaroo. I've invented Magic Sneakers!"

Bonnie's husband followed her outside. Amazed, he watched Bonnie hop over their car with no trouble at all. He gasped, "You should make more of those super shoes."

"Good idea," Bonnie agreed. "Everyone will want a pair." Then she added, "But I'll need lots of gukum."

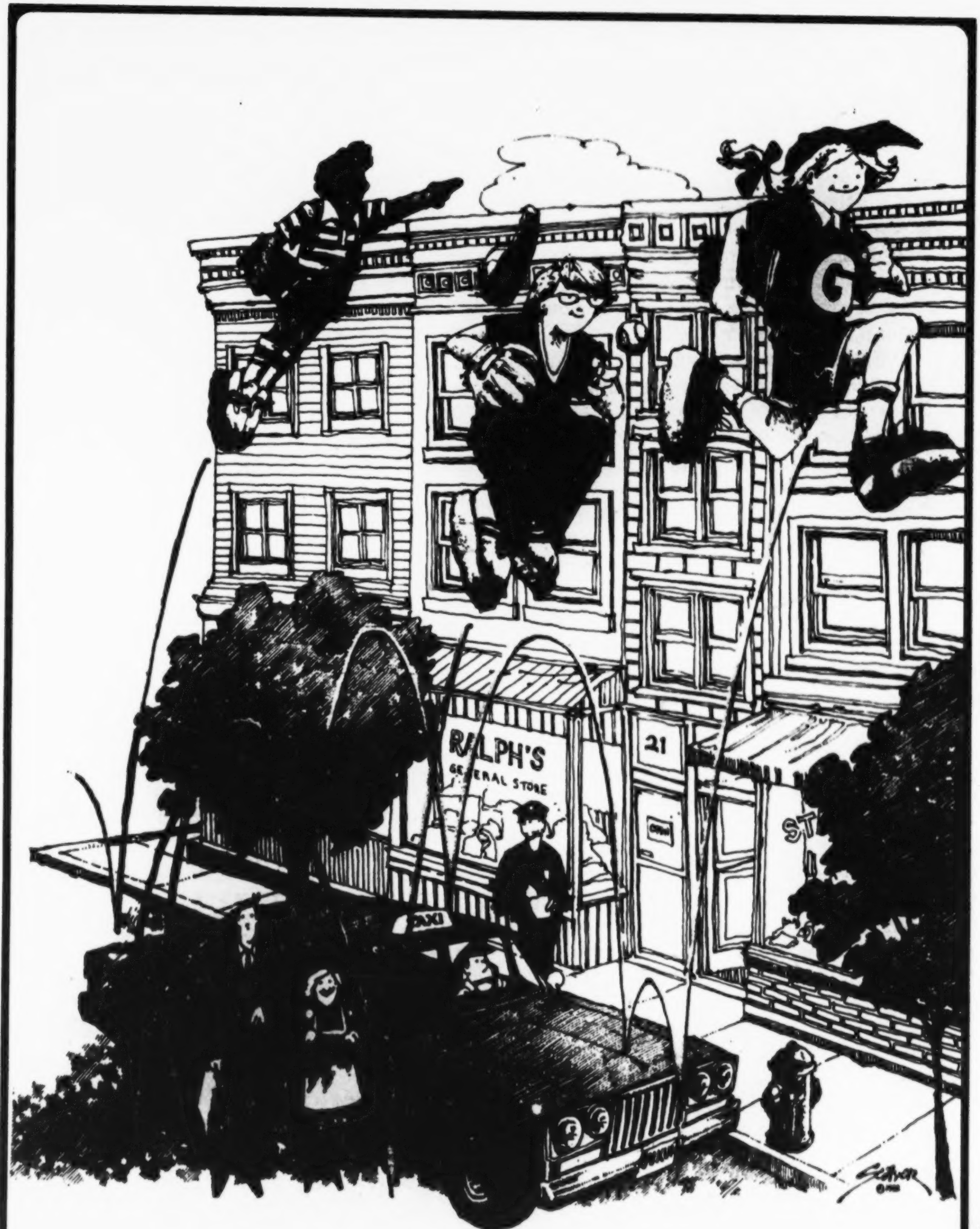
A few days later Ms. Gobble sat in the office of her silent factory. She had just finished reading a letter from Bonnie. For the first time in weeks, Ms. Gobble whistled. Then she phoned Mr. Epa, the government man. When he heard about Bonnie's plan for gukum, he was very happy. "Congratulations, Ms. Gobble," he said. "You're back in business!"

Kids all over the country began wearing Bonnie's sneakers. Not only did the children get to school on time with their leaping shoes, but they also broke all the old records for running and jumping. Before long Bonnie Bunsen's Magic Sneakers were famous all over the world. A new event was even added to the Olympics. It was called the Bunsen Bounce.

Best of all, many other factory owners started looking for ways to turn their waste products into something useful. *The End*

Rangers: This may seem like just a funny story, but scientists really are finding good uses for wastes. For example, before raw wool can be made into yarn, it must be washed. From this dirty water comes a product used in making crayons. And some of the makers of apple juice have a "sweet" way of using their wastes. After they squeeze the juice from apples, they make *pectin* from the mushy remains of the fruit. Pectin is used in making jam and candy!

Now, why don't you do some research of your own? Call your town's chamber of commerce and ask what kinds of industries there are in your community. Then call or visit these industries and find out what happens to their wastes. *R.R.*


G
RALPH'S
GENERAL STORE
21
ST
TAXI

WORKSHEET

GUKUM

1. What does Mrs. Gobble's factory produce?

2. What is the waste product from her factory called?

3. What kind of complaints was Mrs. Gobble's factory receiving?

4. What are some of the ways in which Mrs. Gobble tried to get rid of the gukum?

5. Who finally came up with a way to solve Mrs. Gobble's problem?

6. How did Mrs. Gobble's problem and her solution affect (or influence)businessmen in the area?

7. Circle (in the story) the sentence that explains the problem in Mrs. Gobble's factory.

8. Underline (in the story) the sentence that explains how the solution was discovered.

9. Suppose Bonnie and Mrs. Gobble hadn't known each other or that Bonnie hadn't been able to find out who made the gukum. Can you suggest a way that they could have gotten in contact with each other?

Virginia Waste Exchange

WHAT IS IT?

The disposal of industrial waste, particularly waste that creates environmental and health hazards, is a matter of major concern. An ideal way of reducing the problem of what to do with waste products is to recycle them through another company's industrial process, thus using one company's waste as another's raw material. The Virginia Waste Exchange operates on this principle. It serves as an information clearinghouse set up on a confidential basis through which potential buyers and sellers of waste materials can locate one another.

WHAT ARE THE BENEFITS?

Waste exchange makes good sense both economically and environmentally. In addition to saving on disposal costs, participating industries benefit from waste transfer by establishing useful business contacts, by learning about new resource recovery and management technologies, and by boosting their public image. Waste exchange also protects the environment. Raw materials are conserved, along with the energy to process those raw materials. Waste exchange also encourages the reuse of energy-rich waste materials such as waste oils and wood wastes. By reducing the need for land disposal, waste transfer reduces pollution of the air and groundwater and extends the lives of disposal sites. Waste exchange also serves as a means of protecting public health and welfare by reducing the amount of hazardous wastes that must be disposed of.

HOW DOES IT WORK?

The VWE accomplishes its goal of matching one company's waste with another's need by publishing a catalog of waste materials wanted and available. The catalog is published at least twice a year. All listings in the catalog are identified by a code to protect the confidentiality of the listers. If a company is interested in one of the materials listed in the catalog, it should contact the Exchange. The Exchange will forward the inquirer's name to the listing company. It is then up to the lister to contact the inquirer if he is interested in arranging a transfer. This confidential method of operation is made available to industries wishing to protect trade secrets that may be revealed through the identification and quantity of waste generated.

Listings may also be made on a non-confidential basis. This method accelerates the flow of information. With this method, the waste generator submits a listing to the Exchange catalog but signs a release from confidentiality. When an inquiry is made concerning the listing, the Exchange gives the name of the lister to the inquirer as well as forwarding the name of the inquirer to the lister. Either party can then initiate contact and negotiations. In either case, the Exchange does not participate in the negotiations or actual transfer of materials. The VWE does not determine content, legality of transfer, storage requirements, waste handling or disposal requirements, nor will it determine what constitutes a hazardous substance. Those details are the responsibilities of buyer and seller.

WHO CAN USE IT?

Any company that has either waste products with potential reuse value or a need for such materials may use the VWE. Both members and non-members of the Virginia State Chamber of Commerce are encouraged to participate in the Exchange. Nominal listing and subscription fees are charged to help cover the costs of printing and distributing the catalog. Listers will receive the catalog free of charge. Listing forms may be obtained from the Exchange.

The Virginia Waste Exchange is operated as a service of the Virginia State Chamber of Commerce. The Virginia Solid Waste Commission initiated efforts to establish the Exchange and continues to assist the Chamber with the Exchange program. Funding for establishment of the Exchange was provided through a grant from the Virginia Environmental Endowment. Continued support for the operation of the Exchange is provided by the Chamber.

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ID CODE NUMBER: MA-7
DESCRIPTION: Fly ash and bottom ash from coal combustion in electric generation
QUANTITY: 350,000 tons per year
PACKAGING: Bulk
LOCATION: West central and southwest Virginia

ID CODE NUMBER: MA-8
DESCRIPTION: Tire cord quality nylon, polyester and fiberglass waste
QUANTITY: Loose nylon (greige) -- 6,000 pounds per month, nylon treated -- 4,000 pounds per month, polyester on 5 pound tubes -- 1,500 pounds per month, loose polyester (greige) -- 2,000 pounds per month, nylon on 5 pound tubes -- 3,000 pounds per month, loose fiberglass -- 750 pounds per month
PACKAGING: 1,000 pound bales and 250 pound boxes (palletized)
LOCATION: Central Virginia

ID CODE NUMBER: MA-9
DESCRIPTION: Press wash waste liquids -- flash point generally not greater than 140° F
QUANTITY: 440 gallons per month
PACKAGING: 8 drums per month
LOCATION: Northwest Virginia

ID CODE NUMBER: MA-10
DESCRIPTION: Potassium hydroxide liquid, 40% concentration; some silica particles present
QUANTITY: 3,000 gallons per month
PACKAGING: Bulk -- liquid
LOCATION: Hampton

ID CODE NUMBER: MA-11
DESCRIPTION: Sodium hydroxide 76%, solid
QUANTITY: 3,000 pounds per month
PACKAGING: 55 gallon steel drums
LOCATION: Hampton

ID CODE NUMBER: MA-12
DESCRIPTION: Sodium nitrate solution with some nickel and chrome present
QUANTITY: 4,000 gallons per month
PACKAGING: Bulk liquid
LOCATION: Hampton

ID CODE NUMBER: MA-13
DESCRIPTION: Sodium nitrate sludge with nickel and chrome present
QUANTITY: 5,000 pounds per month
PACKAGING: 55 gallon steel drums
LOCATION: Hampton

ID CODE NUMBER: MA-14
DESCRIPTION: Waste lubricating oil
QUANTITY: 250 gallons per month
PACKAGING: 55 gallon steel drums
LOCATION: Hampton

ID CODE NUMBER: MA-15
DESCRIPTION: Spent finishing materials, excellent for fuel or as BTU boosters in kiln operations
QUANTITY: Sporadic; approximately 500 gallons per month
PACKAGING: Drums
LOCATION: Southwest Virginia

ID CODE NUMBER: MA-16
DESCRIPTION: Solvent - DuBois Chem Inc. GC3520 -- a chlorinated solvent contaminated by an oil residue
QUANTITY: 50 gallons per week; 1,500 gallons on hand in steel drums
PACKAGING: Drums per DOT 17H
LOCATION: Lexington -- west central Virginia

ID CODE NUMBER: MA-17
DESCRIPTION: Cement kiln dust, for acid neutralization or odor control; approximate chemical composition available on request
QUANTITY: 1,000-3,000 tons per month available, continuous basis
PACKAGING: Bulk (purchaser's truck)
LOCATION: Western Virginia - Roanoke area

ID CODE NUMBER: MA-18
DESCRIPTION: Zinc hydroxide sludge; contains 50% zinc on a dry basis
QUANTITY: 4 tons per week, continuously generated
PACKAGING: Bulk
LOCATION: Southeastern Virginia

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ID CODE NUMBER: MA-64
DESCRIPTION: Used office furniture (steel)
QUANTITY: Frequently available
PACKAGING: Loose
LOCATION: Northern Virginia

ID CODE NUMBER: MA-65
DESCRIPTION: Paper - scrap
QUANTITY: 60 tons per day
PACKAGING: Loose
LOCATION: Northern Virginia

ID CODE NUMBER: MA-66
DESCRIPTION: Wooden skids, pallets - hard and soft wood
QUANTITY: Approximately 150 skids per day
PACKAGING: Loose
LOCATION: Northern Virginia

ID CODE NUMBER: MA-67
DESCRIPTION: Peanut skins--crude protein not less than 9%, crude fat not less than 10%, crude fiber not more than 22%; 10,340 BTU per pound
QUANTITY: Truck loads preferred, continuously available
PACKAGING: Semi-bulk cardboard boxes--900 pounds to 1400 pounds each
LOCATION: Southeastern Virginia

ID CODE NUMBER: MA-68
DESCRIPTION: Used grease, lithium based, extracted from rail car bearings
QUANTITY: 18 to 20 drums monthly (400 pound drums)
PACKAGING: Drum
LOCATION: Norfolk, Richmond

ID CODE NUMBER: MA-69
DESCRIPTION: Cellulose acetate fibre waste
QUANTITY: 8 tons per day, continuous basis
PACKAGING: Tri-pak
LOCATION: Richmond

ID CODE NUMBER: MA-70
DESCRIPTION: Fly ash and bottom ash from coal fired industrial boiler
QUANTITY: 3,000 tons per year
PACKAGING: Bulk
LOCATION: Richmond

ID CODE NUMBER: MA-71
DESCRIPTION: Charcoal dust
QUANTITY: 800 pounds per week
PACKAGING: Drum (200 pounds)
LOCATION: Richmond

ID CODE NUMBER: MA-72
DESCRIPTION: 4 mil poly bags (20 3/4"x15"x30")
QUANTITY: 40,000, one time basis
PACKAGING: Rolls
LOCATION: Richmond

ID CODE NUMBER: MA-73
DESCRIPTION: Mixed waste adhesive (PVA non-toxic)
QUANTITY: 150 gallons per week, continuous basis
PACKAGING: 55 gallon drums
LOCATION: Richmond

ID CODE NUMBER: MA-74
DESCRIPTION: Paint sludge, non-hazardous, residue from painting operation, no thinners, semi-solid
QUANTITY: 2,000 pounds per month
PACKAGING: Drums
LOCATION: Richmond

ID CODE NUMBER: MA-75
DESCRIPTION: Fly ash - coal boiler
QUANTITY: 10 tons per day
PACKAGING: Bulk
LOCATION: Richmond

ID CODE NUMBER: MA-76
DESCRIPTION: Paper mill sludge, approximately 90% wood cellulose on a dry basis
QUANTITY: 500,000 cubic yards, one time
PACKAGING: Bulk
LOCATION: Richmond

ID CODE NUMBER: MA-77
DESCRIPTION: Scrap wooden pallets, approximately 48"
QUANTITY: 50 per day
PACKAGING: Bulk
LOCATION: Richmond

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Acid Rain: A Basic Problem

MAJOR PURPOSES

*To consider the possible effects of acid rain
*To develop an awareness about the scope of the problem
*To recognize the controversial aspects of this topic

RELATED CONCEPTS/UNDERSTANDINGS/QUESTIONS/AND SKILLS

*To compare the pH of various samples of natural precipitation
*To observe through laboratory experimentation how a lower than normal pH affects living organisms
*To provide background information about the "dead" lakes in the Adirondacks and elsewhere
*To recognize reactive effects on non-living materials, such as the deterioration of statues, paint, and corrosion of metal
*To understand why some areas in the United States are more sensitive to acid rain than others
*To consider the link between acid rain and various metals dissolved in water

INSTRUCTIONAL APPROACH

The following activities are suitable for students in life science, general science, physical science or biology at the middle or junior high school level. Background information concerning the probable causes of acid rain can be found in the bibliography and newspaper and magazine articles.

Special materials needed are the following: pH papers having a wide range of 0-12 or a pH meter, a pH scale as a handout for the students, maps of the U.S. showing affected areas, a large city or county map of your area, a wall map of the world, marble chips, and tarnished pennies for experimentation.

By far the most dramatic way to introduce students to the problem of acid rain is through visuals. An excellent overview is gained from the 80-slide presentation, "Acid Rain - The Choice Is Ours." This is listed in the reference section. As an alternative, the instructor may invite a speaker, have a photographic display of some of the effects of acid rain or provide a reading assignment. After students have collected some background information, they may perform experiments to focus on certain relevant concepts.

There is a commercially available set of 12 color transparencies entitled "Acid Rain Visual Learning Packet" which may be used. Details are listed in the bibliography of this topic.

When the students have completed the lessons, they should be able to explain pH and how it is used to measure levels of acidity and why some soils are able to neutralize or buffer acid rain. They also will observe how acidic environments affect aquatic and plant life.

OVERVIEW

Acid rain represents a relatively new environmental concern, and students should recognize that there is much controversy surrounding it. There are those who propose prompt action in further limiting sulfur dioxide emissions while conceding more research is needed to clarify the scientific uncertainties surrounding the topic. They contend that much is known and what is not known should not be used as an excuse not to act. Major insights into the workings of complex natural systems come slowly, they acknowledge, but stress that we cannot wait to make difficult political decisions.

Others say that such action would be extremely costly in terms of taxes and electrical rates with little or no possibility that the problem would be addressed successfully. They cite what they consider as hard evidence in scientific literature that reducing sulfur dioxide emissions has not reduced the acidity of rain so far. They point to alternative explanations of "dying" lakes and forests and alternative ways of dealing with the problem that they consider more consistent with scientific data and less costly by possibly billions of dollars.

As students engage in the following activities, they should be aware that they are working on specific aspects of a much larger and more complex issue. A good presentation of the positions summarized above can be found in pieces on the editorial page of the Wall Street Journal, June 28, 1984.

Acid rain is probably caused by emissions of sulphur dioxide and nitrogen oxides which combine with moisture in the air to produce sulphuric and nitric acids. Sandstone sculptures produced in the 1700's in Germany remained virtually undisturbed for 200 years until the early 1900's. By 1969 they had become severely eroded because of the action of acid rain. There is a debate over the extent to which electric power plants which burn fossil fuels contribute to the problem. A secondary source of pollution seems to be automobile exhausts. The Clean Air Act of 1970, and subsequent amendments in 1977, were enacted to address the problem of acid rain. In a effort to improve air quality around the plants, many utilities raised their smoke stacks, some as high as 2000 feet. This may have served to spread the pollution further.

The U.S. releases about 50 million metric tons of sulfur and nitrogen oxides into the atmosphere yearly. Substantial amounts of these chemicals are converted into acid rain. Actually acid rain is a misnomer. It can be acid snow, sleet, gas aerosol, solid particles....... "Acid deposition" would be the more correct term to use.

Methods have been devised to reduce the pollution which causes acid rain as reported in the article referenced from Popular Science.

ACTIVITIES

Learning About pH

The pH scale is a number scale ranging from 0-14 which is used to determine the acidity of a solution. A strong acid is indicated by a 0 reading; 14 means a strong base (alkaline) and 7 represents a neutral reading. The acidity of a substance is determined by the percentage of Hydrogen ions present, hence the abbreviation, pH. The pH values increase logarithmically, not arithmetically. Therefore a pH value of 4 is 10 times more acid than a pH of 5 and 100 times stronger than a pH of 6.

In separate containers, pour small amounts of the following liquids; rain water, tap water, vinegar, dissolved baking soda, ammonia, lemon juice and cola soft drink. Use pH paper to determine the pH of each liquid. Have students rank these substances on the pH scale. Add a marble chip (the kind used in landscaping will do) and a tarnished penny to each of the solutions. If balances are available, have students weigh the marble piece before and after the experiment. Observe after 48 hours and record the visual change of each liquid on the marble and the penny.

Have students explain why the Statue of Liberty, marble statuary, and grave headstones have undergone extensive deterioration in recent years.

To economize on the use of pH paper, a drop or even less of the solution to be tested can be spotted on a piece of test paper that is less than 5 mm square.

To illustrate the effect of the buffering action that occurs naturally in some lakes, have students drop pinches of agriculture lime into a vinegar solution until a pH range between 5-6, that of normal rain water, is achieved. If brought to a pH of 7, this process is known as neutralization. Students should test the beakers or cups of liquids from the preceding experiment to determine if the pH changed in 48 hours. Both students and teachers are warned to take care and make every effort to respect these common agents as potentially dangerous chemicals. They can be flushed individually down the drain as a disposal procedure or completely neutralized prior to disposal.

A True or False Practice Quiz

1. The lower the numerical value on the pH scale, the more basic (alkaline) the solution will be.	(F)
2. A pH of 3 is 10 times more acid than a pH of 4, and a pH of 4 is 10 times more acid than a pH of 5.	(T)
3. Granite and other igneous rocks resist weathering by acid rain.	(T)
4. Granite and other igneous rocks are good for buffering the effects of acid rain on lakes.	(F)
5. Acid rain mainly affects areas close to its source.	(F)

How Acid Is the Rain? An Experimental Survey

You may wish to have the students bring in samples of rain (or snow) a few days prior to this activity. It is also possible to have them collect it and freeze the precipitation for a month or so ahead of class use. Instruct them to use a glass jar or cup lined with a new plastic bag (zip lock type is nice) with the top edge turned back over the rim. This collection device should be placed in the open, because run-off from tree leaves or gutters will include other pollutants. Samples should be clearly identified by date, name of collector, and location of collection.

Have students measure the pH of their samples. Record this on a class chart. If possible, put a street or county map of your geographic area on a bulletin board and have students locate their collection sites using tacks. If tacks are close together, compare the pH of these samples. Additional samples could be collected and recorded over an extended period of time, and the factors that might cause different readings could be discussed.

Suggested Topics for Class Discussion

Why are the samples collected so similar or different in pH?

What natural conditions might affect the pH of the samples? (Wind direction, type of soil involved, collection at the beginning or end of the rain.)

What man-made features affect samples? (Nearness to major highways, proximity to industry, open pit mining areas, recently plowed fields.)

How could you use this information?

What is your personal reaction to this activity?

The Effect of an Acid Environment on Aquatic Life

Using vinegar, agricultural lime and tap water, set up a series of containers having pH values of of 3, 4, 5, 6, 7 and 8. After measuring the pH of tap water, vinegar can be added to lower the pH and the lime is added to produce higher pH values. Add several hydra or daphnia (available from a biological supply company) or a single species of small aquatic invertebrate collected from local ponds. Using a hand lens or stero-microscope, observe the organisms for 30 minutes, recording any apparent changes. The teacher may choose to allow the solutions to stand for 48 hours and record any "long-term" effects.

What pH range appears to be the most favorable?

What effects occur as the pH was lowered?

What effects could this have on fish, birds and humans?

The Effect of an Acid Environment on Plants

Mix large quantities of water having pH values of 3, 4, 5 and 6 using vinegar and lime as described in the previous activity. Fill four paper cups with potting soil, poking holes in the bottom for drainage and plant 10 seeds of one type in each cup. Radish, pea, rye grass or any kind of bean will do. Water one cup of plants with water having a pH value of 3, the other cup with pH 4 water and so on. Try to keep the pots uniformly moist. Permit growth for a least three weeks and preferably longer, observing and recording the growth rates and other pertinent data such as leaf size and color, general health conditions, germination time and percent germination. As a class, discuss what effect low pH values have on the developing plants.

To ensure reliability in drawing conclusions, the class should be divided into several groups with each group conducting identical tests.

Extensions and Applications As Applied to Acid Rain

Student could write to classes or relatives in different localities asking for pH readings of rain samples taken in that area, along with a description of the area (rural, urban). Students may want to design a questionnaire to be sent with each request, asking about the process they used in collecting the data. Then they could collect and analyze the returned data.

Scientists have found that the more acidic the water, the greater the amount of metals, such as aluminum, zinc, copper and mercury that can be dissolved in the water from surrounding polluted soils. These metals may be highly toxic to fish and serve to compound the problem. Drinking water having low pH levels can dissolve lead solder in pipes which can result in lead poisoning. The pH of the water also influences the amount of dissolved copper in drinking water. A student may search current periodicals to find articles related to this aspect of the problem and report them to the class.

Acid rain also affects mature leaves by stripping away the waxy coating that protects the leaves from infestation by insects and water loss. Pitting of leaves, shortened needles and bleached chlorophyll also result in a slowdown in photosynthesis. This apparently has been the case in Canada, Germany, and Scandanavia where forests have been severely damaged. In the U.S., similar damage is suspected in California, Tennessee, North Carolina and Virginia.

As a class, students may design an experiment to test this effect. They would search the current literature for ideas. Class discussion may center on plant selection such as why some species are more tolerant and how long would it take to observe a response. Other parameters to be considered would include the method of application, experimental design, and pH of the control group.

For a class project students may design a bulletin board or free standing acid rain display to explain the topic or their experimental findings.

Students may search current periodicals to determine the status of provisions of the Clean Air Act and what industries have done or not done to comply with this legislation.

VOCABULARY

Acid rain, particulate matter, alkaline, basic, neutral, acid, sulfur dioxide, nitrogen oxides, Clean Air Act, aerosol, solid particles, acid deposition.

REFERENCES AND MATERIALS

"Acid Rain," 20 min., color, slide/cassette program, 1980, New England Water Pollution Control Commission, free loan from the State Water Control Board Library, 2111 N. Hamilton Street, Richmond, VA 23219.

"Acid Rain - The Choice Is Ours," 20 min. color, slide/cassette program, 1980, $40. Friends of the Boundary Waters Wilderness, Inc., 111 E. Franklin Avenue, Minneapolis, MN 55404.

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ACKNOWLEDGMENTS

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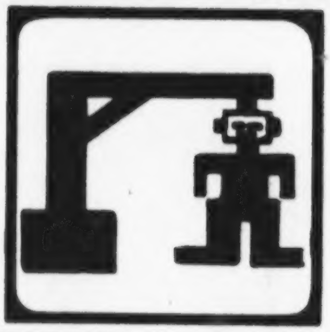
Hang The Dumper:
An Apple II Vocabulary Game



MAJOR PURPOSES

*To encourage the use of computers and educational games

*To provide experience with vocabulary relative to the topic

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS/QUESTIONS

*To provide an exercise using the Apple or other computer system

*To develop specific vocabulary words

INSTRUCTIONAL APPROACH

This topic uses the program provided or a diskette (disk) available from the Learning Resource Center in the James Cabell Library at Virginia Commonwealth University, Richmond, VA. The disk is can be copied using Apple CopyA and is obviously free domain material. It can also be modified for additional vocabulary words on this and other topics. Instructions are included.

Students can either type the program into any computer or borrow the disk for the Apple II. The program is like "Hang Man". After it is booted the spaces for specific letters for pre-programmed vocabulary words are shown. You are asked to guess each letter and, if correct, specific places where those letters occur are filled. After a few letters are made successfully, you should be able to get a feel for that specific word. If wrong letters are selected, then the hangman gallows is shown and for each wrong letter another portion of the man (you) being hanged is added. If your misses are sufficient to complete the total man, then the program indicates you are dead. You either complete the word or you are hanged before you can continue to the next word. When there is a short phrase used there are no spaces between the words. The letters are run together.

OVERVIEW/BACKGROUND INFORMATION

The following list of words have been used in this program. It is recommended that you also should have the students know the definitions of the terms. We recognize that a game such as this does have its educational drawbacks.

Words: toxic, hazardous, waste, dump, asbestos, carcinogen, ignitable, containment, cradle to grave, incineration, leachate, Love Canal, manifest, mercury, mutagen, PCB, pentaborane, radioactive, secure landfill, teratogen, toxicology, superfund, sludge, pesticide, recycle, PBB, dioxin, orphan site, friable, non-friable, OSHA, EPA, corrosive, lethal, insecticide.

INSTRUCTIONS FOR STUDENT USE

Insert disk into Apple II disk drive
Turn Apple on to boot program
Type--RUN HANG THE DUMPER
Title should appear
RTN
Instructions for playing
RTN
Game starts

TO LIST AND PRINT PROGRAM

RUN HANG THE DUMPER
Title appears
CTR C RTN
Screen shows break at 32010
LIST
After listing, PR#1 RTN
LIST RTN
It prints
To clear, turn computer off

INSTRUCTIONS FOR EDITING

RUN HANG THE DUMPER
When disk drive light goes off use, ESC Reset
LIST (line number)
Type new line (i.e., 8 ----- sentence ----RTN
LIST 8 to check it, RTN
SAVE (plus title of game)

To change vocabulary words:

LIST 20000 and word
Continue changes

ACKNOWLEDGMENTS

These games were edited, copied, or modified from the programs developed by Dr. Daniel Yates and Miss. Virginia Ellett, of the Richmond Mathematics and Science Center, Richmond, VA. Miss. Ellett contributed directly.

TOTAL PRINTED PROGRAM -- SPECIFICALLY FOR APPLE II
(Can be modified and used on other systems.)

```
0  REM  ****         ****
1  GOSUB 60000
2  REM  TO CHANGE/ADD WORDS. SEE
3  REM  STATEMENTS 20000-30000 &
     7
4 :::
5  CALL  - 936
8  VTAB 2: HTAB 16: PRINT "HANG T
     HE DUMPER"
10  VTAB 6: PRINT "THE WORDS USED
      IN THIS GAME OF HANG THE DU
     MPER"
11  VTAB 8: HTAB 2: PRINT "ARE TH
     E ONES THAT WERE USED IN THE
      "
12  VTAB 10: HTAB 10:
13  PRINT "VEE/VCU TOXIC SUBSTANC
     ES AND HAZARDOUS WASTE EDUCA
     TION PROJECT"
14  VTAB 14: HTAB 14: PRINT "PREP
     ARED BY"
15  VTAB 16: PRINT "VIRGINIA C. E
     LLETT AND DANIEL S. YATES"
16  VTAB 17: HTAB 4: PRINT "MATHE
     MATICS AND SCIENCE CENTER"
17  VTAB 18: HTAB 14: PRINT "RICH
     MOND. VA"
18  FOR X = 1 TO 3000: NEXT X: GOSUB
     32000
19  CALL  - 936
20  VTAB 2: PRINT "HANG THE DUMPE
     R IS PLAYED LIKE HANGMAN"
21  VTAB 4: PRINT "WHEN YOU SEE T
     HE DASHES. TYPE ONE LETTER"
22  VTAB 6: PRINT "AND PRESS THE
     <RETURN> KEY."
23  FOR X = 1 TO 3000: NEXT X: GOSUB
     32000
24  CALL  - 936
26 COUNT = 0
28  POKE 1014.0: &  INT ((33) *  RND
     (1)) + 20000
```

```
30  GR
32  COLOR= 8
34  FOR I = 28 TO 33
40  HLIN 3.11 AT I
50  NEXT I
60  COLOR= 9
70  HLIN 8,28 AT 9: HLIN 8,28 AT
     10
80  VLIN 9,27 AT 7: PLOT 11,11: PLOT
     10,12: PLOT 9,13: PLOT 8,14
90  COLOR= 13
100  VLIN 11,14 AT 27
130 N = 0
140  VTAB 21: FOR X = 1 TO  LEN (
     A$): HTAB X * 2: PRINT "-";:
      NEXT X
160  VTAB 22
170  HTAB 1: CALL  - 868: HTAB 15
     : PRINT "YOUR GUESS > ";
171  INPUT G$
175  ON ( LEN (G$) <  > 1) <  > 0
      GOTO 6000
180  GOSUB 1000
190  GOTO 160
1000 HIT = 0
1001 G = ( ASC (G$) + 128)
1002  FOR K = 1617 TO 1617 + 2 *
      LEN (A$): ON (G =  PEEK (K)
     ) <  > 0 GOTO 5000: NEXT K
1004  FOR L = 1872 TO 1872 + N: ON
     (G =  PEEK (L)) <  > 0 GOTO
     5000: NEXT L
1010  FOR I = 1 TO  LEN (A$)
1020  ON (G$ <  >  MID$ (A$,I.I -
     (I) + 1)) <  > 0 GOTO 1050
1030 HIT = 1
1040  VTAB 21: HTAB I * 2: PRINT
     G$;: PRINT ""
1045 COUNT = COUNT + 1
1047  ON (COUNT =  LEN (A$)) <  >
     0 GOTO 31000
1050  NEXT I
1060  IF  NOT HIT THEN  GOSUB 200
     0
1065  FOR T = 1 TO 200: NEXT T
1070  RETURN
2000  REM  INCORREXCT GUESS
```

```
2001  FOR T = 1 TO 25
2002 M =  PEEK ( - 16336)
2003  NEXT T
2010 N = N + 1
2020  VTAB 23: HTAB N: PRINT G$::

2030  POKE 1014.45: & N * 1000 +
     10000
5000  VTAB 22: CALL  - 868: PRINT
     "YOU'VE ALREADY GUESSED THAT
     ! GUESS > "::  GOTO 171
6000  VTAB 22: CALL  - 868: PRINT
     "INVALID GUESS. TRY AGAIN >
     "::  GOTO 171
11000  COLOR= 15: HLIN 26.28 AT 1
     5: HLIN 25.29 AT 16: HLIN 25
     .29 AT 17: HLIN 26.28 AT 18:
      RETURN
12000  COLOR= 1: PLOT 26.16: PLOT
     28.16: RETURN
13000  COLOR= 2: PLOT 27.18: RETURN

14000  COLOR= 15: PLOT 27.19: RETURN

15000  COLOR= 4: FOR L = 26 TO 28
     : VLIN 20.26 AT L: NEXT L: HLIN
     25.29 AT 27: RETURN
16000  COLOR= 15: VLIN 20.21 AT 2
     5: VLIN 20.25 AT 24: RETURN

17000  VLIN 20.21 AT 29: VLIN 20.
     25 AT 30: RETURN
18000  VLIN 28.33 AT 25: VLIN 28.
     33 AT 26: HLIN 23.24 AT 33: RETURN
19000  VLIN 28.33 AT 28: VLIN 28.
     33 AT 29: HLIN 30.31 AT 33
19010  VLIN 28.33 AT 29
19020  HLIN 30.31 AT 33
19030  FOR T = 1 TO 300: NEXT T
19033  VTAB 22: HTAB 1: CALL  - 8
     68: HTAB 15: PRINT "YOUR GUY
      JUST KICKED OFF!"
19035  FOR G = 1 TO 400
19040 M =  PEEK ( - 16336)
19050  NEXT G
19075  CALL  - 868: FOR T = 1 TO
     300: NEXT T
19080  PRINT "THE WORD IS "::  PRINT
```

```
     A$:: PRINT ""
19090  GOTO 31005
20000 A$ = "TOXIC": RETURN
20001 A$ = "HAZARDOUS": RETURN
20002 A$ = "WASTE": RETURN
20003 A$ = "DUMP": RETURN
20004 A$ = "ASBESTOS": RETURN
20005 A$ = "CARCINOGEN": RETURN
20006 A$ = "IGNITABLE": RETURN
20007 A$ = "CONTAINMENT": RETURN

20008 A$ = "CRADLETOGRAVE": RETURN

20009 A$ = "INCINERATION": RETURN

20010 A$ = "LEACHATE": RETURN
20011 A$ = "LOVECANAL": RETURN
20012 A$ = "MANIFEST": RETURN
20013 A$ = "MERCURY": RETURN
20014 A$ = "MUTAGEN": RETURN
20015 A$ = "PCB": RETURN
20016 A$ = "PENTABORANE": RETURN

20017 A$ = "RADIOACTIVE": RETURN

20018 A$ = "SECUREDLANDFILL": RETURN

20019 A$ = "TERATOGEN": RETURN
20020 A$ = "TOXICOLOGY": RETURN
20021 A$ = "SUPERFUND": RETURN
20022 A$ = "DDT": RETURN
20023 A$ = "PESTICIDE": RETURN
20024 A$ = "RECYCLE": RETURN
20025 A$ = "DIOXIN": RETURN
20026 A$ = "OSHA": RETURN
20027 A$ = "EPA": RETURN
20028 A$ = "CORROSIVE": RETURN
20029 A$ = "LETHAL": RETURN
20030 A$ = "HEAVYMETAL": RETURN
20031 A$ = "ORPHANSITE": RETURN
20032 A$ = "PBB": RETURN
20033 A$ = "FRIABLE": RETURN
20034 A$ = "NONFRIABLE": RETURN
20035 A$ = "INSECTICIDE": RETURN
```

```
20036 A$ = "ENCAPSULATION": RETURN

20037 A$ = "MESOTHELIOMA": RETURN

20038 A$ = "SLUDGE": RETURN
20039 A$ = "VALLEYOFTHEDRUMS": RETURN

20040 A$ = "POLLUTION": RETURN
31000  CALL  - 868: FOR T = 1 TO
      300: NEXT T: PRINT "   YOU L
      IVE...":: FOR T = 1 TO 500: NEXT
      T: PRINT "   FOR NOW..."
31005  FOR T = 1 TO 2000: NEXT T
31010  TEXT : CALL  - 936
31020  VTAB 8: HTAB 14
31030  PRINT "P)LAY AGAIN"
31040  VTAB 10: HTAB 14
31050  PRINT "Q)UIT"
31060  VTAB 14: HTAB 22
31070  PRINT "WHICH?":
31080  INPUT CY$
31085  ON (CY$ = "P") <  > 0 GOTO
      24
31086  CALL  - 936
31087  VTAB 12: HTAB 16
31088  PRINT "BYE BYE . . ."
31089  FOR X = 1 TO 2000: NEXT X
31090  CALL  - 936
31092  END
32000  VTAB 24: HTAB 4: PRINT "PR
      ESS <RETURN> TO CONTINUE";
32010  INPUT ZX$
32020  RETURN
32600  END
60000  POKE 1013,76: POKE 1015,3:
      A$ = "300:20 7B DD 20 52 E7
      20 1A D6 90 1D A9 03 20 D6 D
      3 A5 B9 48 A5 B8 48 A5 76 48
       A5 75 48 A9 B0 48 20 B7 00
      20 41 D9 4C D2 D7 A2 5A 4C 1
      2 D4 20 7B DD 20 52 E7 20 1A
       D6 90 F0 4C 41 D9 N D9C6G"
60010  FOR I = 1 TO  LEN (A$): POKE
      511 + I,128 +  ASC ( MID$ (A
      $.1.1)): NEXT : POKE 72,0: CALL
       - 144: RETURN
```

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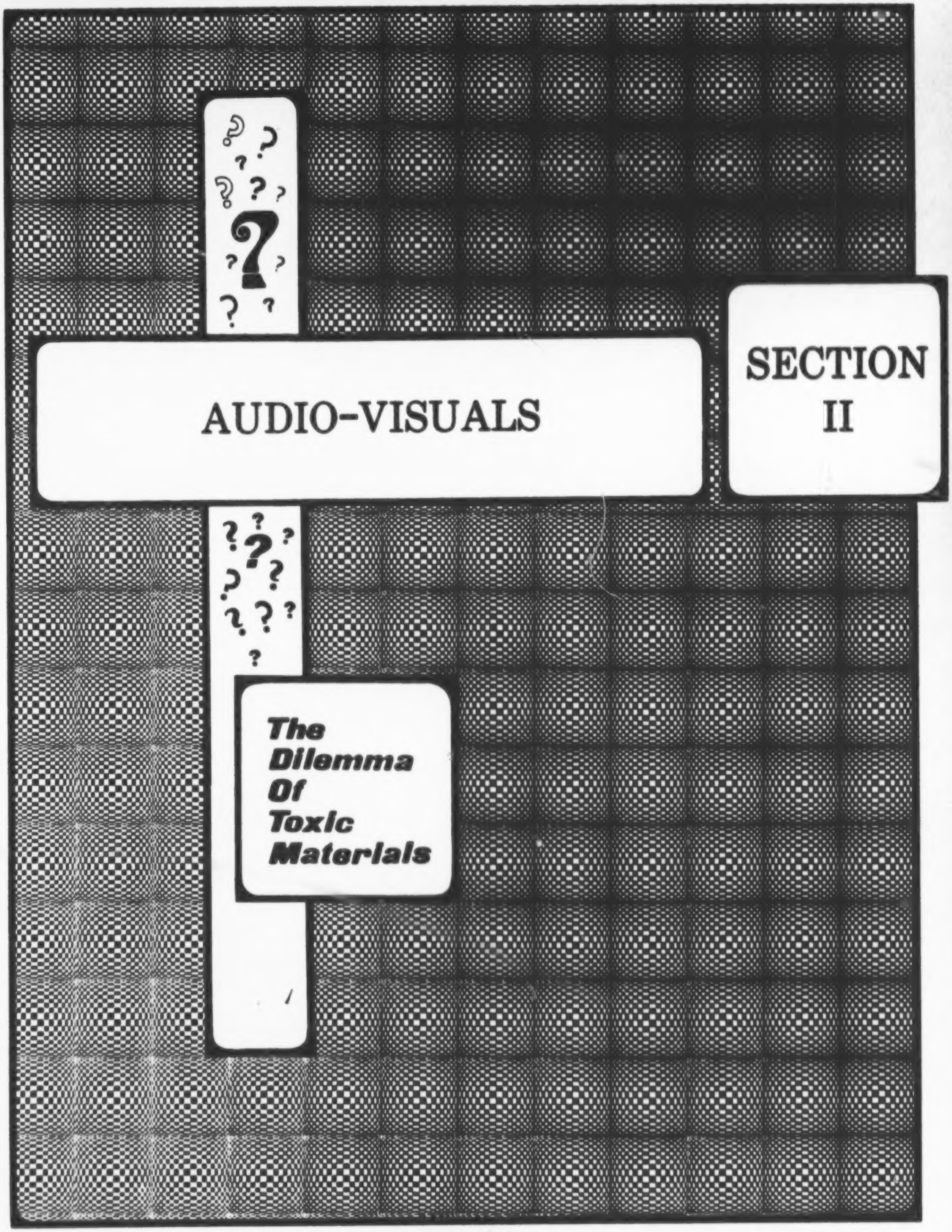

AUDIO-VISUALS

SECTION II

The Dilemma Of Toxic Materials

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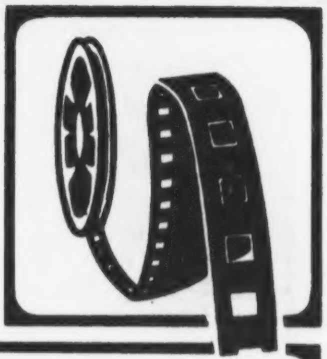
Audio-Visual Resource Guide



MAJOR PURPOSE

The purpose of this section is to aid teachers in identifying, obtaining, and using audio-visual materials related to toxic substances and hazardous wastes. The following films, tapes, and slides were found to be appropriate for science and social studies teachers and classes. All, however, should be previewed prior to use to determine if the material is suitable for a particular teaching/learning situation. Even if it is not, teachers should find the contents personally helpful in developing insights about various aspects and viewpoints related to the issue. One should be aware that many of the films, tapes and slides are presented from the viewpoint of either an industry, an environmental group(s) or a governmental agency. This tendency should be evident, but it is important that the material be used in a balanced and unbiased way. Regardless of the viewpoint presented, each position represented contains valid points to be considered in good faith. Teachers are encouraged to up-date this section as more material becomes available. Most items listed were recently produced or released.

ALPHABETICAL LISTING OF AUDIO-VISUALS

ACID RAIN - THE CHOICE IS OURS
AGENT ORANGE: A STORY OF DIGNITY AND DOUBT
ASBESTOS: A LETHAL LEGACY
ASBESTOS REMOVAL
ASBESTOS: A WAY TO DUSTY DEATH
BILL SMITH´S NEW CHEMICAL
BLACK TIDE
BUDWORKS
CHEMICAL BALANCE, THE
COST OF COTTON, THE
DEALING WITH TOXIC SUBSTANCES: A CITIZEN´S ROLE
GROUND WATER: THE HIDDEN RESERVOIR
HAZARDOUS WASTES, INTRODUCTION TO
HAZARDOUS WASTE DISPOSAL
HAZARDOUS WASTE IS EVERYBODY´S PROBLEM: GET INVOLVED
HAZARDOUS WASTE OPTIONS
HAZARDOUS WASTE: THE SEARCH FOR SOLUTIONS
IN OUR OWN BACKYARD: THE FIRST LOVE CANAL
KILLING GROUND, THE
MORE THAN A PAYCHECK
NEED TO KNOW, THE
OUR HIDDEN NATIONAL PRODUCT

PCP´S: WHAT HAVE WE LEARNED?
PLAGUE ON OUR CHILDREN: DIOXINS (I), PCB´S (II)
POLITICS OF POISON
RECYCLING IN ACTION
RISE AND FALL OF DDT, THE
SAFE INSECT CONTROL - NO SILENT SPRING
SERPENT FRUITS
SONG OF THE CANARY
TYLER, TEXAS
WATER CRISIS, THE
WASTE: PENALTY OF AFFLUENCE

TITLE/BRIEF DESCRIPTION/COMMENTS/ORDERING INFORMATION

ACID RAIN - THE CHOICE IS OURS

20 min., color, slide/cassette, 80 slides, 1980, $40. purchase. Designed to be purchased as a teaching aid, this audio visual gives a very complete overview of the acid rain problem.

Friends of the Boundary Waters Wilderness, Inc.
111 East Franklin Avenue
Minneapolis, MN 55404

AGENT ORANGE: A STORY OF DIGNITY AND DOUBT

28 min., color film, video cassette. Presents the use of the herbicide in the Vietnam War and records and documents statements by veterans and their families about how their health has been affected. Gives the controversy about the Defense Dept., Veterans Admin. and Chemical Companies who refuse to adequately test, treat and compensate veterans. Good for an adult group and beneficial to the science teacher but may need some comments for objectivity if presented to upper middle school students.

New Day Films
P.O. Box 315
Franklin Lakes, NJ 07417

Agent Orange Victims International
42 West, 13th Street, Suite 1 C
New York, NY 10011

(203) 567-4336

ASBESTOS: A LETHAL LEGACY

55 min., color, Nova program, $65 rental. Many workers were interviewed who were ignorant of the toxic effects of asbestos. There is an emphasis on the need to educate workers concerning the regulations concerning worker protection. Even if the worker knows of the asbestos problem, why does he continue to return to the job? Medical symptoms are also illustrated.

King Features
Entertainment
235 East 45th Street
New York, NY 10017

Nova (transcript)
Asbestos: A Lethal Legacy
Box 322
Boston, MA 02134

ASBESTOS REMOVAL

25 min., color, slide/cassette, 124 slides free rental. Presents a good overview of the health problems associated with asbestos and gives details about the procedures for removing asbestos from buildings. Is quite concerned with worker safety and often is used as part of worker safety instruction.

WACO, Inc.
P.O. Box 24347
2924 Bells Road
Richmond, VA 23224 (804) 271-0111

ASBESTOS: WAY TO DUSTY DEATH

48 min., color, 1979, $40. rental. Develops the history of the use and abuse of asbestos. Discusses the present problems in schools.

ABC Learning Resources
1330 Avenue of the Americas
New York, NY 10019

BILL SMITH'S NEW CHEMICAL

23 min., color, 1979, free rental. Describes the need to balance the benefits and risks of synthetic chemicals. It contrasts sharply with "Serpent Fruits." If the two films were used together they would make a full period presentation.

Modern Talking Pictures
5000 North Park Street
St. Petersburg, FL 33709 (813) 541-5763

BLACK TIDE

58 min., color, $65 rental, Nova Series, often repeated on PBS. Describes the devastation of the French Brittany Coast when the tanker, Amoco Cadiz wrecked. It develops the point that these types of disasters will continue to occur if international agreement on tanker standards are not reached.

Time/Life Video Distribution Center
P.O. Box 644
Paramus, NJ 07652 (201) 843-4545

BUDWORKS

35 min., color, #30 - $50 rental. Looks at citizen's organizing efforts and

corporate attitudes about pesticide spraying in New Brunswick, Canada. Pesticides have been sprayed there longer than anywhere else in the world.

Green Mountain Post Films
P.O. Box 177
Montague, MA 01351

CHEMICAL BALANCE, THE

12 min., color, 63 slides with audio cassette, $40 purchase. This set tells what the chemical industry is doing to minimize the risks and maximize the benefits of chemicals through research and initiative. Chemical industry orientation but interesting.

Chemical Manufacturers Association
Communications Department
2501 M Street, N.W.
Washington, DC 20037

COST OF COTTON, THE

30 min., color, $50 - $75 rental. Looks at the effect of massive pesticide use on worker-family health in developing nations. A Spanish version is available also.

Solid Waste Information
EPA
Cincinnati, OH 45368 (513) 648-6362

DEALING WITH TOXIC SUBSTANCES: A CITIZEN'S ROLE

15 min., slide/cassette, color, 1980, EPA produced. Explains how citizens can get involved in the effort to control this national problem. Explains also TSCA's authority and toxic laws. It has accompanying literature.

Urban Environmental Conference
666 11th Street, N.W.
Washington, DC 20001

GROUND WATER: THE HIDDEN RESERVOIR

19 min., color, 1971, $32/3 days rental. The significance of ground water and the necessity for protection are discussed in the film. The hydrologic cycle and aquifers are illustrated.

The Media Guild
P.O. Box 881
Solana Beach, CA 92075

HAZARDOUS MATERIALS, INTRODUCTION TO

28 min., color film. It emphasizes numerous and dramatic incidents in FL, TE, NY, CT and other states. Dramatic footage of fires and poisonous gas transportation accidents are used to develop the approach to handling these incidents. It shows the fireman's responsibility at such incidents. Science students should enjoy the dramatic photography. Used in some fireman training programs.

Courtner Films Distributing Center
121 N.W. Crystal STreet
Crystal River, FL 32629

HAZARDOUS WASTE DISPOSAL

20 min., color, 50 slide set, $40 purchase. This slide set was designed for classroom use and covers Love Canal, Valley of the Drums, The Brickyard in Kentucky, Elizabeth City in New Jersey, PCB spill in North Carolina and clean up operations. Examples of ground water contamination are pictured in several states. Disposal methods such as secure landfill, deep well injection, incineration on land and at sea and chemical treatment are illustrated. This series seems quite suitable for the middle school science and social science classroom.

James L. Ruhle & Associates
P.O. Box 4301
Fullerton, CA 92634 (714) 526-6120

HAZARDOUS WASTE IS EVERYBODY'S PROBLEM: GET INVOLVED

20 min., Contains 140 slides with a cassette tape, free rental. Production funded by EPA. Presents a good overview of the whole problem of waste and hazardous waste. From the National Association of Conservation Districts

National Association of Conservation Districts
1025 Vermont Avenue, NW Room 730
Washington, DC 20005 (202) 347-5995 Will help locate local copies.

Va. Soil & Water Conservation Commission
203 Governor Street, Suite 206
Richmond, VA 23219 (804) 786-3334

HAZARDOUS WASTE OPTIONS

24 min., color, EPA produced, $40 rental or free. Documents hazardous waste management operations. It includes recycling, waste treatment, landfilling, incineration, deep well injection and land treatment.

Stuart Finley Inc. ($40 rental)
3428 Mansfield Road
Falls Church, VA 22041

(703) 820-7700

Modern Talking Picture Service (free)
5000 North Park Street
St. Petersburg, FL 33709

(813) 541-5763

Va. State Dept. of Health (free)
Bureau of Hazardous Waste Management
James Monroe Building, 101 N. 14th Street
Richmond, VA 23219 (804) 225-2698

HAZARDOUS WASTE: THE SEARCH FOR SOLUTIONs

58 & 35 min., color, 3/4 inch videocassette or 16 mm film, $75/55 rental. It shows what people can do to help themselves and the results achieved. The program deals with the problem from an environmentalist point of view. It presents the right-to-know laws in CA, health surveys from OH and citizen lobbies in MA & PA. A very appropriate film made in 1981 that has been shown on PBS. Consider calling your local PBS station and requesting information about having it broadcast.

Nicolas J. Kaufman Productions
P.O. Box 315
Franklin Lakes, NJ 07417 (201) 891-8240

IN OUR OWN BACKYARD: THE FIRST LOVE CANAL

59 min., color, 3/4 inch videocassette, or 16 mm film, $45 rental. An overview of the Love Canal problem that concentrates on citizen action and procedures to achieve positive support. It does illustrate the biological, economic, sociological and psychological problems encountered in such incidents. Quite emotional and better suited for the teacher, older and more mature students but could be used in upper level classes in middle school both in the sciences and social sciences.

Bullfrog Films, Inc.
Oley, PA 19547 (215) 779-8226

KILLING GROUND, THE

48 min., color, 1979, $70 rental, free VA Dept. of Health. A dramatic presentation of the effects of improper chemical waste dumping in Montague, MI, Shakopee, MN, Baton Rouge, LA and the Love Canal area of Niagara Falls, NY.

ABC Learning Resources
1330 Avenue of the Americas
New York, NY 10019

Virginia Department of Health
Bureau of Hazardous Waste Management
James Monore Building, 101 N. 14th Street
Richmond, VA 23219 (804) 225-2698

MORE THAN A PAYCHECK

28 min., color, $25 rental. Workers in certain industries are contaminated with chemicals that may cause cancer or other health problems. The film recommends solutions.

National Audio Visual Center
Government Services Administration
Att: Order Section RR
Washington, DC 20409

NEED TO KNOW, THE

28 min., color, film or videotape, free rental or purchase from CMA below. A fairly unbiased film produced by the chemical industry that presents an overall view of the toxic waste problem. It discusses orphan sites and emphasizes their threat. Many solutions to the disposal problems are presented.

Modern Talking Picture Service
5000 Park Street North
St. Petersburg, FL 33709

(813) 541-5763

Chemical Manufacturers Assoc.
Att: Communications Dept.
2501 M Street, N.W.
Washington, DC 20037

(202) 887-1100

OUR HIDDEN NATIONAL PRODUCT

25 min., color film, 1979, $45 rental. It is concerned with determining the location of a hazardous waste disposal site and the problems associated with this procedure. Alternative solutions are discussed.

Durrin Films, Inc.
4926 Sedgwick Street, N.W.
Washington, DC 20016

PCP´S: WHAT HAVE WE LEARNED?

30 min., video tape, color, 1980, free loan. It describes a spill of PCP caused by a ship wreck in the Mississippi River Gulf Outlet. PCP is a preservative that is quite toxic to aquatic life.

Ecology Center of Louisiana
P.O. Box 19064
New Orleans, LA 70179

PLAGUE ON OUR CHILDREN

A Nova series, PBS program often repeated on Educational TV and possibly can be requested for viewing by calling your local PBS station. It consists of two parts that examine the use and disposal of toxic substances.

PART I: DIOXINS

57 min., color, PBS program, $65 rental. Totally explores the use of the herbicide, dioxin and the problems associated with its use.

PART II: PCB'S

57 min., color, PBS program, $65 rental. Discusses the Love Canal incident and the problems of polychlorinated biphenyls.

Time/Life Video Distribution Center
P.O. Box 644
Paramus, NJ 07652 (201) 843-4545

POLITICS OF POISON

53 min., color, $75 rental. Reports on the health and environmental effects of herbicidal spraying in northern CA and OR.

KRON
1001 Van Ness Avenue
San Francisco, CA 94109

RECYCLING IN ACTION

14 min., color, 1973, $16 rental. It shows how everyone benefits and stresses the necessity of community solid waste reclamation. Illustrates a project that is working.

Lifelong Learning Films
Univ. California Extension
Media Center
Berkeley, CA 94720

RISE AND FALL OF DDT, THE

18 min., color film, $25 rental. The controversy around DDT is explored. The pesticide was considered a miracle substance when it was first developed, but now it is banned in the USA.

Time/Life Multimedia
Time & Life Building, Room 32-48
New York, NY 10020

SAFE INSECT CONTROL - NO SILENT SPRING

14 min., color, 1973, $16 rental. An older film: The case for controlling agricultural pests by reinforcing their natural enemies rather than using chemical insecticides is argued by scientists from the University of California at Riverside.

Luis Argenta
444 West 46th Street, No. 10
New York, NY 10036

SERPENT FRUITS

30 & 60' min. versions, color, free rental. Covers the case histories of the synthetic chemicals, 2,4, 5-T, DES and PBB. Labor,industry and government views are presented.

Lifelong Learning Films
University of California Extension
Media Center
Berkeley, CA 94720

SONG OF THE CANARY

58 min., color, 1979, $70 rental. Part one documents the national scandal that arose when workers found out that they were sterile from pesticide DBCP. Part two discusses brown lung and related problems in the Carolinas.

New Day Films
P.O. Box 315
Franklin Lakes, NJ 07417

TYLER, TEXAS

30 min., video tape, black and white, $50 rental. The health hazards of workers exposed to asbestos are presented.

KERA
3000 Harry Hines Blvd.
Dallas, TX 75201

WATER CRISIS, THE

57 min., color, Nova program, $65 rental. It covers water problems all over the country and highlights troubles with acid rain, overdrafting the aquifers, drought, disinfecting methods that may cause cancer and industrial waste.

Time/Life Video Distribution Center
P.O. Box 644
Paramus, NJ 07652 (201) 843-4545

WASTE: PENALTY OF AFFLUENCE

18 min., color, 1972, $10 rental. It explores and details three major solutions to the problem of disposal, salvaging scrap metal, processing animal waste into fodder, and regenerating use of oils. Gives some example of land, water and air

pollution.

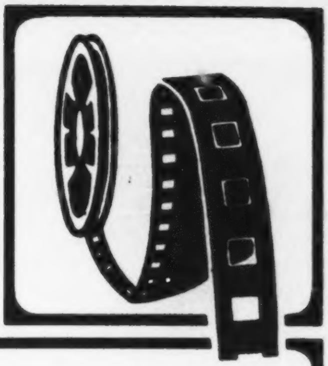
Social Science Films
Visual Aids Service
Univ. of Illinois
1325 South Oak Street
Champaign, IL 61820

ACKNOWLEDGMENTS

Numerous parts of this edited version were originally developed and evaluated by William S. Hastings, Jr., a faculty member at Thomas Dale High School, Chester, Virginia.

SPACE FOR ADDITIONAL AUDIO-VISUALS AS ENCOUNTERED BY THE TEACHER

Teaching Guide
For Specific Audio-Visuals



MAJOR PURPOSE

This section provides a more detailed description of eight specific audio-visual programs. They were selected as examples of what is available and how such material might be used.

Each description includes the following sections: Major Purposes, Related Concepts/Skills/Understandings/Questions, Instructional Approach, Overview/Background, Activities, Teaching Aids, Availibility, Vocabulary, and Acknowledgments. Questions with answers and labeled drawings have been designed so answers and labels can be covered and thus eliminated before they are photocopied and distributed to students.

Of the eight audio-visuals described, two originated as television programs, two are slide/cassette programs, and four are films or video-tapes. Obviously, few teachers will have all of these audio-visuals readily available to them, but with some planning, it should be possible to obtain all of the items if needed. Naturally, such material should be previewed before use to determine if it is appropriate for each specific class.

A LIST OF AUDIO-VISUALS PRESENTED IN THIS SECTION

A Fire Department's Approach to Hazardous Material Incidents - Speaker And Film

"Asbestos: A Lethal Legacy" - A NOVA Production

"Asbestos Removal" - An Informative Slide/Cassette Program From WACO

"Hazardous Waste Is Everybody's Problem" - A Slide/Cassette Program

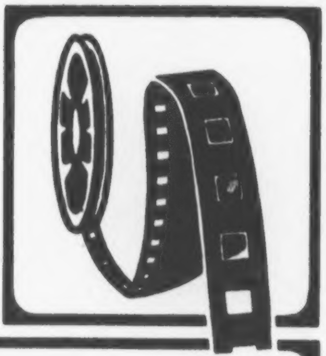
"Hazardous Waste Options" - An EPA Film

"Hazardous Waste: The Search For Solutions" - A PBS/TV Program

"In Our Own Backyards: The First Love Canal"

"The Need To Know" - A Film From The Chemical Manufacturers Association

A Fire Department's Approach To Hazardous Material Incidents: Speaker and Film



MAJOR PURPOSES

*To introduce sample incident situations that have occurred when toxic substances and hazardous materials are transported
*To illustrate the dangers from transportation incidents as well as which agencies are responsible
*To make students aware of the problems associated with a burning liquid evaporating vapor explosion, BLEVE

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS/QUESTIONS

*To point out that trucks and railroad tank cars that contain hazardous material must be labeled
*To apply the gas laws involving temperature and pressure to BLEVE incidents
*To introduce the dangers of poisonous gas and explosion
*To introduce the concepts of carcinogenesis, toxicity, mutagenesis and environmental pollution

INSTRUCTIONAL APPROACH

It is necessary to contact the local fire department for a speaker and the use of their film. The film is entitled "Introduction To Hazardous Materials." Many fire departments have a copy of this film or they can borrow it from another locality. Nearly every county or city fire department should have someone on their staff who specializes in handling hazardous material incidents and making presentations. Obviously, the availability and speaker's effectiveness will vary from geographic area to area but the overall impression and interest generated by personal experiences should provide a high interest experience. A telephone call to the fire chief in the community should be sufficient to locate the person assigned to public presentations of this type. As an example we have contacted the fire department in the Richmond metropolitan areas and talked to the specific individuals concerned with this situation. As expected, all three of the individuals that we contacted were cooperative and stated that they would be willing to work with teachers as guest speakers in their jurisdiction. They were:

Chesterfield County: Sergeant Doug Malispino, (804) 748-5100, film & speaker
City of Richmond: Ass't Fire Marshall, Irving S. Friend, Jr., (804) 780-8811
Henrico County: Captain Dawson, (804) 264-0881, speaker only

Thus the format suggested is that of a guest speaker who would bring photographs and relate experiences and problems that have been encountered at hazardous material incidents. The film would follow and then discussion led by the teacher and assisted by the guest speaker. The series of short answer questions may be used as review, homework or a quiz. It is anticipated that the use of the speaker and film would require more than a normal class period and such scheduling plans would have to be initiated ahead of time. Also there is the possibilility of borrowing or renting the film and using the questions and discussion segments only. Remember to thank any guest speakers via written letter. This lesson may best be used in general and physical science classes.

OVERVIEW/BACKGROUND

The 28 minute, color film, "Introduction To Hazardous Materials," is an overview of the fireman's responsibilities at a hazardous site incident. It emphasizes numerous and dramatic incidents in Florida, Tennessee, New York, Connecticut and other states. The labels and signs for trucks and railroad cars are presented. Dramatic footage of fires and poisonous gas incidents are used to develop the approach to handling these incidents.

The problems associated with a BLEVE, burning liquid evaporating vapor explosion should be discussed. The theories and concepts of the gaseous and liquid states as they relate to temperature and pressure are important. These are basically the gas laws. Liquid propane as an example can be cooled and sufficiently compressed until it liquifies (liquefaction). The transporter can ship much greater quantities of liquid than gas. If a tank car or other transporter is involved in an accident such as a derailment and fire, the gas boils and is released. As it leaks and burns it may spread under other transport tanks causing temperature and pressure increases that could lead to additional explosions, burning and the release of poisonous gases. If it explodes the gas will burn in a giant fire ball. It has the general appearance of a nuclear blast and also sends out shock waves. Pieces of tank cars have been known to be found 2500 feet from the incident site.

NOTES FROM SPEAKER/FILM PREVIEW

SHORT ANSWER QUESTIONS

1. What does BLEVE represent? ____________________________ ____ ____	burning liquid evaporating vapor explosion
2. Liquid gas enables the transportation of much ________ quantities of the product.	greater
3. Who is in charge first at a hazardous materials incident? ______________	police
4. If there is a fire at the hazardous materials site incident, who then is responsible? ______________	fireman
5. Name the temperature point when a liquid becomes a gas. __________	boiling point
6. Some tank cars carry liquid propane. True or False	True
7. As the temperature of a tank of liquid gas increases the pressure inside the tank ______________.	increases
8. As the temperature of a gas or liquid decreases the molecules move ______________.	slower
9. & 10. Heated and burning gas/liquids can ___________ and give off _____________ fumes.	explode poisonous

FOLLOW UP ACTIVITIES

Students should be encouraged to collect newspaper articles of hazardous transportation incidents. Such materials should be documented as to source and date. They can be used for brief oral reports to the class or for bulletin board display.

Students may want to become familiar with the DOT identification numbers, guide numbers and placards or symbols required on all transporters. Police, fire departments and emergency service agencies normally have a copy of the list in a booklet provided them from DOT (DOT P 5800.2). This book is entitled, "Hazardous Materials: Emergency Response Guidebook" and can be purchased for $3.00 from J.J. Keller & Associates, Inc., 145 W. Wisconsin Avenue, Neenah, WI 54956. Orders may be made via telephone, 1-800-558-5011.

FILM AVAILABILITY

Most local fire departments will have this film, "Introduction To Hazardous Materials," as part of their training program and it should be available on a free loan basis from them. It is also available for rent and purchase from:

Courter Films Distributing Center
121 N.W. Crystal Street
Crystal River, FL 32629

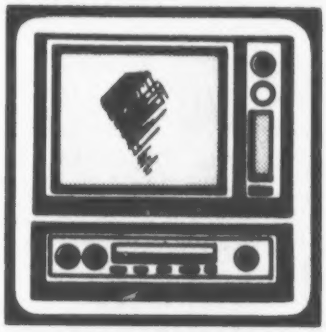
SAMPLE VOCABULARY

BLEVE, liquefaction, liquid state, gaseous state, boiling point, vapor

ACKNOWLEDGMENTS

This edited version was originally developed and evaluated by William S. Hastings, Jr., a faculty member at Thomas Dale High School, Chester, VA.

"Asbestos: A Lethal Legacy"
A NOVA Production



MAJOR PURPOSES

*To introduce the problems associated with asbestos
*To provide background material and a view of the severity of the health problems due to asbestos

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS/QUESTIONS

*To present the origins of the asbestos industry in England and later in the U.S.A and Canada
*To help understand the cause and the effects of asbestosis and mesothelioma
*To be aware of the financial repercussions associated with asbestos related disabilities
*To become familiar with the meaning of the vocabulary words used with this topic

INSTRUCTIONAL APPROACH

This 55 minute production can be rented as a video tape or the local PBS station can be asked to consider putting it into their schedule. They may already have it planned since NOVA often repeats. Also PBS stations usually have some flexibility in their schedule and they may be able to specially work it in for your viewing if it is available to them. They are usually highly cooperative with educational requests such as this. Remember to thank them in writing if they help you.

It is suggested that science classes, life sciences and earth science students study the sample questions included herein and answer them during and after the show. This could be completed as class work or as homework. Certainly a discussion of the topic presented should be led by the teacher. Due to the length of the film (tape) appropriate scheduling for two days of class time will be needed. Why not make it a homework assignment to view the program and answer the questions? This would allow for more class discussion and for checking the answers to the questions.

OVERVIEW/BACKGROUND

Asbestos is a mineral which has been mined and subsequently used for numerous building construction purposes. It was also considered valuable because it does not burn. The occupational health hazards associated with asbestos were identified in the late 1800's, but it was not until recent years that it became clear how serious the problem was. As a result, regulations concerning worker exposure have been enacted. Exposed asbestos is also being removed from buildings according to EPA regulations.

This production deals with asbestos as a toxic substance and its related health hazards. Several testimonies from asbestosis and mesothelioma victims are presented.

SHORT ANSWER QUESTIONS

1. When was asbestos exposure identified as an occupational health hazard?________________	late 1800's
2. Which disease results when trapped asbestos particles lodge in the lung?________________	asbestosis
3. How does cigarette smoking affect the concurrent occurrence and development of the above disease? ______________________________________	increases chances
4. How long does it take for symptoms of asbestosis to appear?_______________	10-15 yrs.
5. Name the cancer that affects the lining of the lung or abdomen as a result of asbestos. __________________________________	mesothelioma
6. Can other cancers also develop from asbestos exposure? ____________________	yes

DISCUSSION/ESSAY QUESTIONS

Identify and discuss various uses of asbestos.

"Asbestos has been used in water pipes, building materials, insulation, floor tile, protective clothing, car brakes and clutches."

When asbestos is found in exposed areas or is the friable type, what action is taken?

"Asbestos is removed using extreme caution and worker protection. Such worker protection and procedures for removing asbestos are thoroughly covered in the WACO production in this book. It is entitled "Asbestos Removal."

When an individual is disabled due to asbestos exposure, what legal recourse can be taken?

"Legal suits are currently pending against asbestos manufacturing companies."

What information should workers be given when exposed to asbestos?

"The video material for this lesson interviewed many workers who were ignorant of the toxic effects of asbestos. There needs to be more emphasis on the current regulations concerning worker protection."

If a worker is aware of the toxicity of asbestos, why would he/she choose to continue the exposure?

"This discussion should be directed by the teacher so that all factors are taken into consideration including economics and the delayed development of symptoms."

FOLLOW UP ACTIVITY

Students should determine the status of the asbestos survey of their school building.

Students may want to write to the local, state or national offices of the American Cancer Society for additional information.

Asbestos
American Cancer Society
Bethesda, MD 20014

VIDEO TAPE & TRANSCRIPT AVAILABILITY

Rental From:	Transcript From:
King Features Entertainment 235 East 45th Street New York, NY 10017	Nova Asbestos: A Lethal Legacy Box 322 Boston, MA 02134

Also broadcast or broadcasts may be requested from local PBS stations.

SAMPLE VOCABULARY

Asbestos, mineral, magnesium, calcium silicate, asbestosis, mesothelioma, slag heaps, white lung

ACKNOWLEDGMENTS

This edited version was originally developed and evaluated by Janice Frossard, a faculty member at St. Gertrude High School, Richmond, VA.

"Asbestos Removal" An Informative Slide/Cassette Program From WACO

MAJOR PURPOSES

*To introduce the general procedures and details followed by a company which removes asbestos
*To emphasize some of the health problems associated with asbestos exposure

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS/QUESTIONS

*To recognize that asbestos is the name for several forms of fibrous minerals which have numerous uses in our everyday world
*To point out that there are four asbestos related diseases: asbestosis, lung cancer, mesothelioma and lung tumors
*To recognize that friable asbestos is a health hazard and can kill
*To identify the three procedures of asbestos control: removal, encapsulation and enclosure
*To provide the student with a general understanding and appreciation for the proper procedures and details necessary for removing asbestos
*To show that OSHA is concerned about asbestos and regulates safety standards for these fibers in the work place

INSTRUCTIONAL APPROACH

It is recommended that a representative from WACO with home offices in Richmond, VA, be invited to bring their copy of the slides/cassette and their synchronized projector/cassette player. In addition, they may also be willing to provide a speaker. Such representatives have been excellent introductory speakers for this program in several university-sponsored workshops, providing a brief history of the asbestos problem and the economics of their company as an introduction prior to the audio visual program. There are 125 slides in the show. Following the program, the teacher, WACO officials and students may interact via general discussion of the topic. Such a program of introductory speaker, audio-visual show and follow up discussion would require more than a normal class period and the teacher should prepare accordingly or plan to split the presentation so the slides are presented on one day and the speaker attends the following day. Also the slides/cassette program may simply be used alone and/or in conjunction with the short answer question set included herein. The questions may be studied before the program or used as a quiz following discussion. This set of questions is quite demanding and asks for substantial information.

OVERVIEW/BACKGROUND

Asbestos was a commonly used building material before the early 1970s. It was used often in industry, for example as an insulator, and its fire resistance and strength also contributed to its use. Unfortunately it is now known that friable asbestos causes health problems and such asbestos must be removed from many facilities. Friable, airborne asbestos, normally is the most dangerous form. Approved OSHA procedures for removal are presented. Some slides illustrate the medical problems associated with asbestosis. Since many older school buildings have asbestos in them, this show, although commercial in nature, will serve middle school earth science classes well.

NOTES FROM VISITING SPEAKER/SLIDE & CASSETTE PREVIEW

SHORT ANSWER/WORKSHEET

1. List the four asbestos-related diseases. ____________ ____________ ____________ ____________	asbestosis lung cancer mesothelioma lung tumors
5. Excessive exposure to asbestos can kill. True or False	true
6. All types of asbestos are dangerous. True or False	false
7. The EPA is working with schools to help remove the problem of loose or ____________ asbestos.	friable
8. List three steps that can be taken to control asbestos. ____________ ____________ ____________	removal encapsulation enclosure
11. The four necessary safety steps that a contractor must follow in safe asbestos removal are: ____________ ____________ ____________ ____________	seal off area wear protective clothing minimize fibers in the air clean up & disposal
15. List the five steps which are necessary to protect the asbestos removal worker. ____________ ____________ ____________ ____________	respirator protective clothing decontamination air monitoring medical exam.
19. When the air is monitored via special filters for asbestos, special ____________ are used to test the samples collected.	microscopes
20. Name the Federal agency which sets standards for asbestos levels in the work place. ____________	OSHA
21. Spraying an asbestos surface with a ____________ will help keep the dust level down when removing the asbestos.	wetting agent
22. The asbestos waste removed is placed in plastic bags and fiber drums for disposal in a proper ____________.	landfill

DISCUSSION QUESTIONS

Do the health problems associated with asbestos exposure appear immediately?

"No. There may be a lag time of 20 to 40 years between exposure and the development of cancer."

Is mesothelioma associated only with asbestos? "Yes" Explain.

FOLLOW UP ACTIVITIES

Check with the school principal or superintendent and determine if your building has been evaluated for asbestos. Inquire about the plans for removal.

Collect newspaper articles, clippings and journal articles for discussion and display. There should be a continual removal of such materials from the buildings in your area.

Earth science students can prepare a short report on the mineral characteristics of asbestos, how it is mined and processed.

Students can identify the many uses of friable and nonfriable asbestos. They should determine what substitute materials are available for use and if they are being used.

Geography students can identify asbestos mining areas and transportation networks to get it to processing centers. History students might examine the history of asbestos mining.

SLIDE/CASSETTE AVAILABILITY

This audio visual program was prepared by WACO and is available from them and a copy has been made for the Va. Commonwealth University Resource Center. A speaker from WACO who introduces the show and answers post show questions is recommended but obviously their services cannot be guaranteed.

WACO Inc. (Free loan)
President, Mr. William Walker
P.O. Box 24347, 2924 Bells Road
Richmond, VA 23224

(804) 271-0111

Cabell Library Learning Resource Center
Va. Commonwealth University Library
901 Park Avenue, Third Floor
Richmond, VA 23284

(804) 257-1109

SAMPLE VOCABULARY

Friable, mesothelioma, asbestosis, encapsulation, respirator, OSHA, minerals

ACKNOWLEDGMENTS

This edited version was originally developed and evaluated by William S. Hastings, Jr., a faculty member of Thomas Dale High School, Chester, VA.

ADDITIONAL NOTES ABOUT ASBESTOS

"Hazardous Waste Is Everybody's Problem" A Slide/Cassette Program

MAJOR PURPOSES

- *To introduce the problem of hazardous waste dump sites and their environmental hazard
- *To illustrate how government became involved in the problem
- *To show how individuals, students and citizens can help and become involved

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS/QUESTIONS

- *To introduce and define the term, "hazardous waste"
- *To become aware that old dump sites pose problems and that there are potentially significant damages associated with such sites
- *To encourage students to become aware of the ecological and human damage that dangerous dump sites and off-site dumping can cause
- *To encourage students to learn the roles that citizens may play regarding hazardous waste management

INSTRUCTIONAL APPROACH

This short, 20 minute audio visual presentation may serve to introduce the broad aspects of waste and hazardous waste. Although the program slides and tape are coded for coordinated presentation, if such a projector system is not available, a regular cassette recorder/player and a 35mm slide projector can be readily substituted.

Students may find it necessary to read over the questions provided herein prior to viewing the show. Thus the questions may be presented as a work sheet or as a quiz for use afterwards. The question format is such that by covering the answer column, the page may be directly photocopied and/or reproduced.

Sufficient discussion time should be allowed following the show. During this time the general questions may be utilized.

The materials are suitable for middle school science and social science classes.

OVERVIEW

This 20 minute, 35 mm slide and audio cassette program was produced by The National Association of Conservation Districts and is directed to citizen awareness of the problem. It was produced and concurrently released about the time of Super Fund approval and does require some updating relevant to this phase of the topic. It asks and answers the following questions: What are hazardous wastes? Where do hazardous wastes come from? Why are some dumps ticking time bombs? What are the dangers from a hazardous site? Where are these dangerous dumps found? Is all hazardous waste found only in dumps? What is the government doing about the disposal problems? What is the role of the local citizen regarding hazardous wastes?

SHORT ANSWER QUESTIONS

1. The most common way of disposing of hazardous waste is in ______________.	landfills
2. The waste disposal site at ____________ near Niagara Falls, NY opened our eyes to the dangers of poor disposal of chemical waste.	Love Canal
3. Persons who were willing to dump hazardous wastes for money but who did not care how they did it were called ______________.	midnight dumpers
4. The EPA defines ________________ as wastes which are ignitable, corrosive, reactive or toxic.	hazardous waste
5. What is the government agency in charge of cleaning up hazardous waste? __________________	EPA
6. In Kentucky the ________________ was an area where chemicals were stored in drums which leaked chemicals into the ground water.	Valley of the Drums
7. ________ is the act which gave the federal government authority to regulate hazardous waste.	RCRA
8. What is a site whose owners cannot be found or cannot afford the cost of clean up? _____________	orphan
9. Industries will pay into the ______________ which will pay for clean up and decontamination of present hazardous waste sites.	superfund
10. A substance that presents an unreasonable risk of injury to health or the environment is said to be ________________.	toxic

QUESTIONS FOR DISCUSSION AND EVALUATION/TESTING

1. How have industries, municipalities disposed of their wastes in the past?

2. How were covered landfills used after World War II?

3. Love Canal: Which company owned and filled the dump?
   What happened to the canal after the chemical company was finished with it?
   What caused people of the Love Canal area to be concerned?
   What have government agencies done with the Love Canal area?

4. Was all hazardous waste placed in disposal sites?

5. What common characteristics did the Congressional Subcommittee find about unsound waste disposal practices in major dump sites in 1979?

6. Identify some of the sites named in the presentation. Choose one and tell of its particular dangers.

7. How is hazardous waste defined by the EPA?

8. List the major points of the Resource Conservation & Recovery Act, RCRA, 1976.

   Federal government was authorized to regulate hazardous waste.
   Regulation should be from the cradle to the grave.
   Industries who create such waste must clean up even if the cost is substantial.

9. Abandoned, orphan, sites should be cleaned up with what funds?

10. What is the Super Fund and who should pay into it?

11. Name six methods for managing waste.

    Reduce volume by modifying industrial process
    Transfer waste to another industry, recycle
    Reprocess the waste to recover energy
    Separate hazardous and nonhazardous waste at its source
    Incinerate or treat waste to make it nonhazardous
    Dispose of hazardous waste in a secure landfill

12. How does the cleaning up of hazardous waste affect the cost of products?

13. How might citizens help prevent pollution such as this?

14. What are some signs to look for that might indicate a dump site?

FOLLOW UP ACTIVITY

What is being done today in the management of hazardous waste in our state?

(Check with your state health department)

What is being done by the Federal Government?

(Check with the appropriate EPA regional office)

Collect & display for discussion newspaper articles and journal articles relating to this topic.

Students can make reports to the class on the information they have collected from the media.

SLIDE/CASSETTE SOURCE AND AVAILABILITY

Produced with an EPA grant for: National Association of Conservation Districts
1025 Vermont Avenue, N.W. Room 730
Washington, D.C. 20005

(202) 347-5995

Copy Available From: Va. Soil & Water Conservation Commission (free rental)
203 Governor Street, Suite 206
Richmond, VA 23219

(804) 786-3334

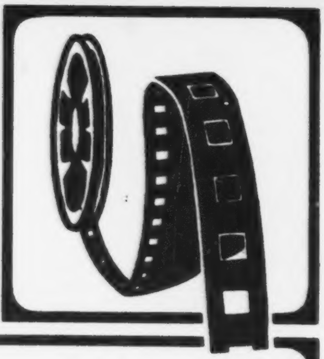
SAMPLE VOCABULARY

Orphan site, off-site dumping, RCRA, Superfund, secure landfill

ACKNOWLEDGMENTS

This edited version was originally developed and evaluated by Edson S. Pederson, a faculty member at the New Community School, Richmond, VA.

"Hazardous Waste Options"
An EPA Film



MAJOR PURPOSES

*To identify the options available concerning hazardous waste disposal
*To recognize and be able to discuss the pros and cons associated with each disposal method and option

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS/QUESTIONS

*To increase environmental awareness
*To develop critical thinking and communication relevant to this topic
*To recognize societal perspectives in scientific issues
*To see the need for management of natural resources

INSTRUCTIONAL APPROACH

This 16 mm (24 minutes) color film produced by the Environmental Protection Agency can be shown to the class to introduce the topic. Provided herein are 15 short answer questions which the students may have available to them as a handout prior to viewing the film. It is advisable that they read these questions prior to viewing.

Also available for post-film discussion led by the teacher, a student leader or used in small discussion groups is a series of general questions about hazardous waste options. They also could be used as essay questions for the students who would seek the answers upon viewing the film. All of these questions should only serve as a guide and the teacher may want to tailor specific questions to the level of the class involved.

OVERVIEW

Hazardous wastes are produced by almost every type of industry or manufacturing process in the world. These waste products come from the manufacturing of many vital products and will continue to be generated as man improves or maintains his standard of living. Yet these wastes can contaminate the ground and surface water, pollute the air, cause fires and explosion, concentrate in the food chain and cause major health problems like miscarriages, birth defects and cancer. "Hazardous Waste Options" presents three major options in which hazardous wastes may be reduced. Those options are reducing the waste at the source, recycling wastes when possible and treating and disposing of the wastes properly.

SHORT ANSWER QUESTIONS

1. What normally happens to a storage drum? ______	rusts
2. Can waste water seep into the ground water? ______	yes
3. Can waste oil be recycled? ______	yes
4. Which is better? recycling or disposal (circle one)	recycling
5. Name three layers of the secure landfill. ______ ______ ______	plastic liner clay layer earth cover
6. How is ground water monitored near a landfill? ______ ______	using surrounding wells
7. High temperature incineration reduces the volume of ______	wastes
8. What are the temperature levels involved in this type of incineration? ______ to ______	1200 to 2300 F
9. What is the major emission from high temperature incineration? ______	steam
10. Why do or would people picket the landfills? ______	They do not want dumps near them.
11. One key to hazardous waste management is that of knowing information and details relating to the hazardous ______ itself.	waste
12. - 14. List three ways that can be used to reduce the amount of waste volume. ______ ______ ______	source recycle treatment & disposal
15. Who produced or sponsored this film? ______	EPA

DISCUSSION/ESSAY QUESTIONS

Why would the sponsor of this film have an interest in hazardous waste?

List several reasons showing the importance of proper disposal of hazardous waste.

Why is recycling better than disposal?

Explain how a secured landfill should be designed.

Do you believe people have a right to picket landfill sites? Why?

Do you think people want to live without the products that generate hazardous wastes?

What options are available for disposal of hazardous wastes?

FILM AVAILABILITY

Stuart Finley, Inc. ($40 rental)
3428 Mansfield Road
Falls Church, VA 22041

(703) 820-7700

Modern Talking Picture Service (free)
3520 Progress Drive, Suite C
Bensalem, PA 19029

Virginia State Department of Health (free)
Bureau of Solid & Hazardous Waste Management
James Monroe Building, 101 N. 14th Street
Richmond, VA 23219 (804) 225-2267

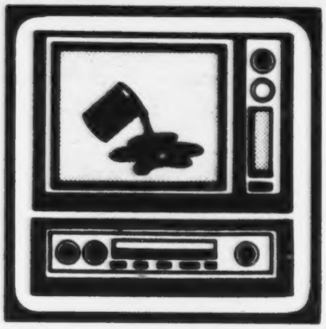
SAMPLE VOCABULARY

Leachate, biodegradable, ground water monitoring, incinerator, deep well injection, secure landfill

ACKNOWLEDGMENTS

This edited version was originally developed and evaluated by Joan Giovannetti, a faculty member at Brookland Middle School, Richmond, VA.

"Hazardous Waste: The Search For Solutions" A PBS/TV Program



MAJOR PURPOSES

- *To examine different approaches that have been used by citizen groups concerned with toxic substances and hazardous wastes
- *To become familiar with some specific examples of the toxic waste problem

RELATED CONCEPTS/UNDERSTANDINGS/SKILLS/QUESTIONS

- *To analyze the objectives of audio-visual presentations and the manner in which they were pursued
- *To become familiar with positions of various groups and consider whether they are presented in an adequate and balanced way
- *To recognize responsibilities of citizens before and after they have become involved in community action
- *To become familiar with some of the questions and trade-offs that are involved in searching for solutions to the toxic substances and hazardous wastes problems

INSTRUCTIONAL APPROACH

"Hazardous Waste: The Search for Solutions" is a tape/film that deals with the problem from an environmentalist point of view. The presentation could be used in social studies classes to address the objectives noted above, for one of its major theses is that hazardous waste is more of a social problem than a scientific one. It is also fair to note that it is still highly suitable for the middle school science class.

The questions provided on the next page can be used by the teacher as a starting point in making students more aware of the content and possible implications of the program. They may have to be restated to be appropriate for your level of students and the purposes you decided to pursue. Each question is related to an aspect of purposes suggested above. They are not, however, meant to exhaust the possibilities one might find in the presentation.

This production is available in four versions: tape and film; full-length and edited. The full-length version is 58 minutes long while the edited one runs 35 minutes. The shorter edition focuses more closely on community action and the solutions. For a small handling fee, the producer/supplier will send a copy for preview for purchase. A study guide is also available.

"Hazardous Waste: ...." has been shown nationally on PBS. Your local station may be willing to reschedule the presentation, if they are willing or able to obtain it. They might be able to work it into their schedule at a time that could be viewed by your class, on a specific evening or even on Saturday or Sunday. Normally they are very cooperative with educational requests.

OVERVIEW

Examples are presented showing actions taken by communities in five states in response to various types of hazardous wastes situations. Among the different approaches shown are the following:

1. "Right-To-Know" laws in CA that enable communities to inspect and regulate local hazardous waste problems.
2. Health surveys in OH that help neighborhoods identify health problems from exposure to toxic substances.
3. Safer methods for disposing of wastes than landfills which are proving to be a contamination problem themselves.
4. Citizen lobbies in MA and PA that are fighting to clean up local dump sites with the federal Superfund program.

DISCUSSION QUESTIONS

The following questions might be used as a basis for discussions or given to students before they view the program to help then get more out of the presentation:

1. What were the different examples of hazardous wastes presented?
2. From these examples can you identify existing or potential sources of hazardous waste in your community?
3. What were the positions of the different parties involved in each case? (i.e. industry, environmentalists, government, ...)
4. Can you tell whether the positions are presented in a fair way? On what basis do you make this judgment? If you are not sure it is fair, what is needed to make such a judgment?
5. What are some of the conflicts or dilemmas involving legal rights of the various parties involved? (i.e. the "right-to-know laws" verses the right to protect trade or company secrets)
6. Can such conflicts be resolved while protecting the rights of the involved parties and still deal with the toxic waste problem in an adequate way? Give examples.
7. What were some of the solutions identified for addressing the problems?

(i.e. alternatives to landfills, ...)

8. To make a constructive and effective contribution to solving the problems, what responsibilities do citizens have? (i.e. understanding the nature of the problem in terms of the various parties involved, alternatives, short and long-term costs, ...)

TAPE/FILM AVAILABILITY

Nicolas J. Kaufaman Productions
P.O. Box 315
Franklin Lakes, NJ 07417

(film rental, $55/75 plus $10/6 handling, Purchase as 3/4 in. cassette or film, $500/375 or $750/475)

(201) 891-8240

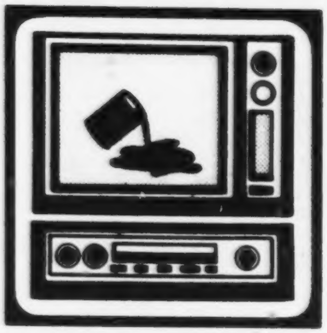
Consider contacting your local PBS station to see if they are willing to air the program for you.

SAMPLE VOCABULARY

Right-to-know laws, landfill, EPA, citizen action groups, PCB's, coal tar dyes, Silicon Valley, trichloroethylene, TCE, toxic, reactive, corrosive, ignitable, acute, chronic, incineration, biological treatment, recycle, right to protect trade secrets

NOTES

"In Our Own Backyards: The First Love Canal"



MAJOR PURPOSES

*To introduce the class to the problems at the Love Canal site, its history, scientific data, political problems, social problems and psychological impact
*To provide a dramatic presentation of a critical situation due to hazardous waste disposal in Niagara Falls
*To illustrate the procedures and effectiveness of a citizen´s action group

RELATED CONCEPTS/UNDERSTANDINGS/SKILLS/QUESTIONS

*To illustrate the complexity of the Love Canal problem
*To point out the potential health problems associated with such a site
*To show how citizens and government attempted to solve the problem
*To warn that such problems may exist elsewhere
*To evaluate if the problem was really solved

INSTRUCTIONAL APPROACH

This color tape/film (59 minutes) has been produced by private business and gives a brief history of the Love Canal/Niagara Falls dump site. Since it describes and follows the development and actions of a citizen´s action group, the plight of its leader (Joan Gibbs) and their interactions with governmental agencies, it will require some balancing comments by the teacher. This material would be most suitable for the more sophisticated sections of ninth grade science and social studies.

Fifty nine minutes is too long for the typical class period, thus it is recommended that the tape/film be spread over two class periods. Certainly a teacher-led discussion should follow with students and teacher being involved. Enclosed for possible use is a series of short answer questions and also a set of discussion questions. Teachers may want to modify these for their own specific use.

OVERVIEW

This tape/film serves as a dramatic introduction for a unit on hazardous wastes and toxic substances. It is substantially a documentary having actual tape of many of the on-site happenings of the local citizen´s action group as led by Lois Gibbs. The tape/film indicates that there may be thousands of similar sites in our country. It does give a history of the removal of people from this site and is primarily concerned with the problems, social, governmental, financial and health of the people who lived outside the first evacuated and fenced area. The historical background included the construction of the original canal and then its use as a hazardous waste landfill by Hooker Chemical Co. and others. In later years the land was sold to the city for $1.00 and a school and houses were built on it. The story broke in 1978 when the health department ordered the evacuation of pregnant women and children and also placed restrictions on the area. The two most pertinent pieces of scientific data were the discovery of the presence of dioxins and a study which indicated that 11 of 36 residents had chromosome damage. This scientific data has been questioned recently.

The tape/film provides the details about the political action of the people who lived there. It also provided some insight into the way our system of government works. It illustrated the relationships and interactions between science, the media, politics, the law and society. It concludes with the federal government giving a loan to the state to buy the homes and relocate the people. Then it goes on to report that there is no way to compensate people monetarily for damage to their health or the potential health problems that may occur in their children. It is quite an emotional presentation.

SHORT ANSWER QUESTIONS

1. The number of hazardous waste sites in the country has been estimated to be in the ________________.	thousands
2. What did the people want who lived in the second ring? ________________________________	relocated & reimbursed
3. Which company was the prime user of the site for hazardous waste?____________________	Hooker Chemical Co.
4. & 5. What are the primary health problems that could be associated with living near the site?__________ ________________________________	birth defects & cancer
6. What extremely dangerous chemical was found in the soil from the site?____________________	dioxin
7. An EPA study indicated that most of the residents had chromosome damage. True or False	false
8. Did the federal government really solve the overall problem at Love Canal? Yes or No	No

DISCUSSION QUESTIONS

1. Explain, in relation to the problem, the meaning of "the tip of the iceberg."
2. What scientific data was in conflict?

3. Was Hooker Chemical Co. really at fault and did they dump illegally?

4. What was the most important lesson to be gained from the Love Canal situation?

5. Who is Lois Gibbs and what was her role in this problem?

6. How were Jane Fonda and the President of the country brought into this controversy?

TAPE/FILM AVAILABILITY

Bullfrog Films Inc. (rental $45 or purchase)
Oley, PA 19547 (215) 779-8226

Cabell Learning Center (free loan)
James Branch Cabell Library
VA Commonwealth University
Richmond, VA 23284 (804)-257-1088

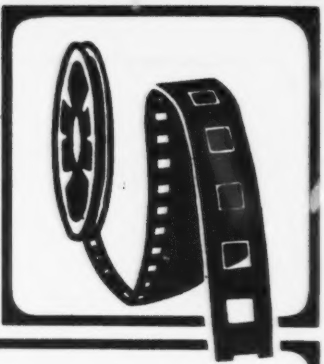
SAMPLE VOCABULARY

Niagara Falls, Love Canal, Hooker Chemical Co., dioxin, chromosome damage, birth defects, EPA, swales, ring 1, ring 2, ring 3, cancer, citizen's action group

ACKNOWLEDGMENTS

This edited version was originally developed and evaluated by William S. Hastings, Jr., a faculty member at Thomas Dale High School, Chester, VA.

"The Need To Know" A Film From The Chemical Manufacturers Association



MAJOR PURPOSES

*To provide the middle school class/teacher with introductory material about toxic and hazardous wastes
*To present the concerns and problems of hazardous waste disposal as addressed by the chemical industry
*To describe research and technologies currently used to safely dispose of such wastes

RELATED CONCEPTS/SKILLS/UNDERSTANDINGS/QUESTIONS

*To understand the problems associated with orphan sites
*To become aware that wastes are produced by all chemical manufacturing processes and that the useful chemicals that are produced by industry play a major role in our way and quality of life
*To understand that hazardous wastes can be treated by such methods as bacterial digestion and incineration
*To be aware of the proper method of building and monitoring a hazardous waste landfill
*To help understand the distinction between hazardous waste and pollution in general

INSTRUCTIONAL APPROACH

This 28 minute, color film is quite chemically oriented yet sufficiently general for use in social science as well as science classes. It can be purchased from the Chemical Manufacturers Association (CMA) either as a film or video tape. They also provide it on a free loan basis.

Provided herein are a series of short answer questions that may be used as a student work sheet or post-film quiz. A series of discussion/essay questions are also included. The latter, should facilitate a teacher-led discussion following the film show.

OVERVIEW

Hazardous wastes are a problem associated with a modern industrialized society and we are very dependent on many chemicals for our way of life. If we are not to sacrifice our standard of living or contaminate our environment with hazardous wastes, effective procedures must be initiated to prevent these wastes from contaminating the environment. This film is concerned with identifying the proper and legal disposal procedures with an emphasis on the theoretical way of accomplishing this objective. Obviously disposal has not always been done correctly in the past. The film does not mention any of the tragic incidents such as Love Canal or the Kepone release.

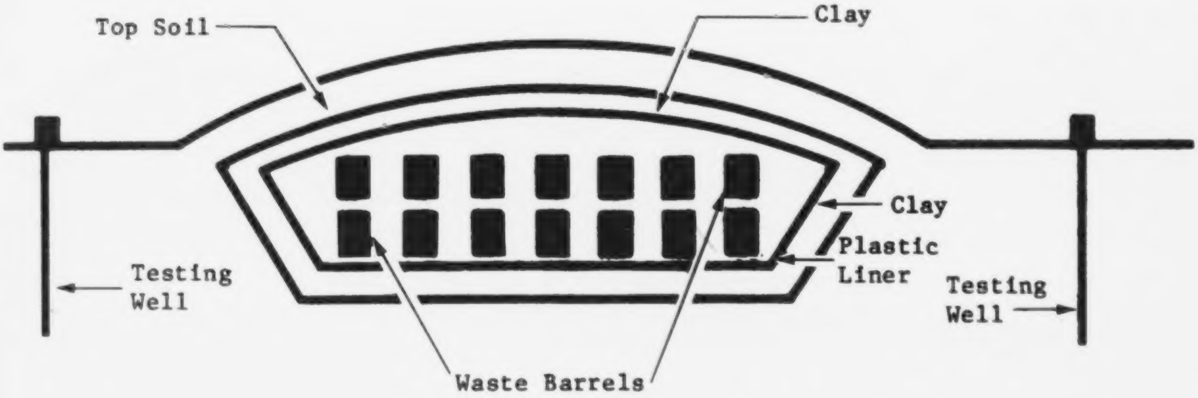
Ron MacLeigh, a nationally known writer and columnist asks questions such as the following: What is being done about hazardous waste disposal? How is it being managed? Why are there orphan dump sites? Is the public safe from the dangers of these wastes? All such questions are answered from a chemical industrial point of view.

SHORT ANSWER QUESTION ACTIVITY

1. Chemical dump sites that need to be cleaned, but lack a financially responsible owner to undertake the project are called ____________________	orphan sites
2. How many billion tons of wastes are produced every year in the USA?____________	4 1/2
3. One percent of this waste is ____________.	hazardous
4. Wastes are produced by all __________ processes.	chemical
5. The best way to approach the production of a new chemical is to manufacture it in the way that produces the________ amount of waste.	least
6. Organic __________ are often present in the discharge of an industrial plant.	wastes
7. Wastes can be digested by the action of ___________.	bacteria
8. Intense _______ can also be used to burn hazardous waste.	heat
9. Both of these above processes convert most of the hazardous wastes into the two harmless substances, ______________ and _____________ and into a small volume of hazardous waste particles for burial.	carbon dioxide & water
10. The remaining material is buried in a ______________.	hazardous waste landfill

DISCUSSION/ESSAY QUESTIONS

1. From the list below, label the parts of this cross sectional view of a a hazardous waste landfill.
top soil, clay, plastic liner, testing well, waste barrels



2. What can go wrong at this site? How is this tested?
"Leachate can get into the ground water. The testing wells should provide immediate information if the site is leaking."

3. Calculate the amount of hazardous waste produced each year in the USA
"45 million tons"

4. What is the Super Fund and how will this money be used?
"Funds provided by the Federal government to pay for the clean up of hazardous waste sites where no financially responsible owner can be located."

5. We often hear statements that indicate that there are benefits and problems associated with the use of chemicals. What does this mean to you?

6. Who produced this film? Do you believe it is completely objective?

7. What is the distinction between hazardous wastes and pollution?
"Hazardous wastes are part of the whole pollution problem. These materials are different from other wastes because they are either toxic, carcinogenic or mutagenic. In many cases they are combustible and corrosive."

FOLLOW UP ACTIVITY

Students should be able to locate sufficient information from periodicals and local newspapers to make a short written or oral report on hazardous waste problems in their state, county or city.

A bulletin board collection of news articles and a file box of popular journal articles would provide further reading for interested students.

FILM AVAILABILITY

Chemical Manufacturers Assoc. (Purchase or free loan)
Attn: Communications Dept.
2501 M Street, N.W.
Washington, DC 20037

(202) 887-1100

Va. State Dept. of Health (free loan)
Bureau of Hazardous Waste Management
James Monroe Building
101 N. 14th Street
Richmond, VA 23219

(804) 225-2267

Modern Talking Picture Service (free loan)
5000 Park Street North
St. Petersburg, FL 33709

(813) 541-5763

Modern Talking Picture Service has regional shipping offices throughout USA and Canada. Film # is 15620.

SAMPLE VOCABULARY

Leachate, plastic liner, incineration, carcinogen, mutagen, pollution, bacterial digestion

ACKNOWLEDGMENT

This edited version was originally developed and evaluated by William S. Hastings, Jr., a faculty member of Thomas Dale High School, Chester, VA.

Video-Tape Summaries Of Lecturers/Speakers And Others

MAJOR PURPOSE

During the Spring, 1983 semester, a Toxic Substances and Hazardous Waste Education Teachers Workshop was held at Hermitage High School in Henrico County, Virginia. This was co-sponsored by Virginia Commonwealth University and the Virginia Environmental Endowment. Speakers representing state agencies and various other environmental and industrial positions were invited to speak to the group. With their permission, their speeches were video-taped and six of them have been produced and edited by Robert A. Bartnick and are available for loan from the Toxic Substances and Hazardous Waste Education Resource Center of the James Branch Cabell Library, Virginia Commonwealth University. Please note that these are not the complete two hour presentations that were presented but an edited version. The tapes include a wide variety of points of view and the teacher should strive for a balanced view when using these and other audio-visual materials.

Included within the alphabetical listing of the tapes and a brief description of each one, there are listed additional video-tapes from the Cabell Library collection. These have been included for their specific Virginia focus, and for their concentration on a significant problem in toxic substances and hazardous waste management. Their brief description follows the Hermitage High School Tapes.

ALPHABETICAL LISTING OF VIDEO-TAPES

ALL THE KINGS MEN
AQUA-NOT-SO-PURA: TOXIC WASTE AND VIRGINIA´S WATERS
AUTUMN´S GOLD: VIRGINIA OYSTERMEN AND NUTRIENT OVERLOAD
DEADLY DEFINITIONS: WHAT MAKES A SUBSTANCE TOXIC?
THE GOOD GUYS & THE BAD GUYS: PUBLIC PERCEPTIONS OF INDUSTRY
THE HAMPTON CYLINDER INCIDENT
SEASONS AND HARVEST OF CHESAPEAKE RIVERS
TOXIC AND HAZARDOUS!: CAUTION - WASTE MANAGEMENT
TOXIC TRUCKIN´: THE TRANSPORTATION INDUSTRY AND HANDLING HAZARDOUS SUBSTANCES
WASTE EXCHANGE: OPTIONS TO INDUSTRIAL WASTE

LOAN INFORMATION

All of the following video-tapes are in color, on 3/4 inch video-tape cassettes, and may be obtained on free loan from the Toxic Substances and Hazardous Wastes Education Resources Center, Learning Resource Center, James Branch Cabell Library, Virginia Commonwealth University, 901 Park Avenue, Richmond, VA 23284.

Their telephone number is 804-257-1088. Borrowers are required to pay the return postage, insure the tapes for $200, and are asked to request the tapes at least four weeks in advance of the scheduled showing.

VIDEO-TAPES OF SPEAKERS AT THE TEACHER'S WORKSHOP

SPONSORED BY

VIRGINIA COMMONWEALTH UNIVERSITY & THE VIRGINIA ENVIRONMENTAL ENDOWMENT

HERMITAGE HIGH SCHOOL, SPRING, 1983

Produced and Edited by Robert A. Bartnik

AQUA-NOT-SO-PURA: TOXIC WASTE AND VIRGINIA'S WATERS

59 minutes

Lecturer: David S. Bailey, Environmental Defense Fund

Defines hazardous waste and the problems of the disposal and perception of waste materials from an environmentalist view-point. Skeptically examines the success of RCRA cradle-to-grave tracking of hazardous wastes and in particular analyzes the Virginia experience with the manifest system and annual reports required under that act. Defines the responsibilities of various state agencies for monitoring and policing hazardous wastes. Describes the social and economic costs of pollution, with special reference to surface and ground water in Virginia.

DEADLY DEFINITIONS: WHAT MAKES A SUBSTANCE TOXIC?

58 minutes

Lecturer: Dr. John Hilchen, former Director, Bureau of Toxic Substances Information, Virginia State Department of Health.

Defines "toxic" in legal terms and in lay terms and gives examples which illustrate differing levels of toxicity. He explains the way in which toxic substances get into the body and the points of damage which result. Additional information is given on the legal responsibilities of manufacturers, and on the responsibility of state employees for maintaining the confidentiality of file materials.

THE GOOD GUYS & THE BAD GUYS: PUBLIC PERCEPTIONS OF INDUSTRY

59 minutes

Lecturer: Richard L. Cook, Safety, Health, and Environmental Affairs
Manager, Dupont Textile Fibers Plant, Chesterfield County,
Virginia

Discusses four issues in Virginia from the industrial point-of-view: (1) confidentiality of regulatory information, (2) disposal sites and the methodology of disposing of hazardous wastes, (3) industrial perceptions of local, state, and federal regulations and administrators, (4) political boundaries and environmental issues, including such topics as acid rain, fluorocarbons, and sewage disposal in the James River. Examines the public perception of industry and hazardous wastes or toxic materials, and the role of the media. Describes the Virginia Toxics Round Table and its accomplishments and the necessity for environmental mediation rather than litigation.

TOXIC AND HAZARDOUS!: CAUTION - WASTE MANAGEMENT

60 minutes

Lecturer: Sandra Morse, Division of Solid and Hazardous Waste
Management, Virginia Department of Health

Provides an overview of hazardous waste management and specifics on hazardous waste management in Virginia. Discussion of RCRA (Resource Conservation Recovery Act) and the mechanics of cradle-to-grave tracking of hazardous wastes leads to an analysis of the role and usefulness of legislation in this field. Ms. Morse also describes and evaluates the NIMBY (Not In My Back Yard) syndrome and the efforts to locate and obtain disposal sites in Virginia.

TOXIC TRUCKIN': THE TRANSPORTATION INDUSTRY AND HANDLING HAZARDOUS SUBSTANCES

59 minutes

Lecturer: Charles Ramsey, formerly with the Virginia Office of Energy
and Emergency Affairs

Describes the growth in size and diversity of the transportation of hazardous materials by truck, train, and barge, and some of the problems associated with such movements. Recent (1982-83) accidents are analyzed to illustrate some of the difficulties encountered, and the need for educating professionals and the public on the proper treatment of hazardous materials is stressed.

WASTE EXCHANGE: OPTIONS TO INDUSTRIAL WASTE

Lecturer: Kitty Cox, Consultant, Virginia Solid Waste Commission, Virginia State Chamber of Commerce

Describes the development and operation of the Virginia Waste Exchange which encourages the recycling of industrial waste through a waste information exchange. Analyzes the operation of waste exchanges in other regions and discusses the prospect of future exchange mechanisms. Indicates that Virginia Waste Exchange will be absorbed by a regional operation.

ADDITIONAL VIDEO-TAPES

SEASONS AND HARVESTS OF CHESAPEAKE RIVERS

29 minutes

Shad fishing methods and processing are first described, with an analysis of the fisherman's yearly calendar and the impact of the Kepone crisis and other chemicals and pollutants on the fishing industry. Includes an analysis of the Wakefield "shad-planking" as a political and cultural event.

AUTUMN'S GOLD: VIRGINIA OYSTERMEN AND NUTRIENT OVERLOAD

15 minutes

Vividly pictures oyster tonging on the Pagan River (a tributary of the James River and Chesapeake Bay) and illustrates the impact of pollution on Smithfield and Battery Park, small communities dependent on local resources to survive. Analyzes the sources of pollution of the Pagan River from agricultural non-point pollution, the packing houses, and development, and discusses the types of pollution and their effects on the river.

Both the above video-tapes are on the same cassette: there is no formal separation between the two. If you wish to show only AUTUMN'S GOLD, run the machine on "fast forward" to approximately 315 on the counter, and you will be at the beginning of that program.

Both tapes were produced by Metro Communication in association with the Sailing Association of Christopher Newport College. They were obtained from the Resource Center for the Humanities, Box 3697 University Station, Division of Continuing Education, Conference Center Room 121, 104 Midmont Lane, Charlottesville, Virginia 22903.

THE HAMPTON CYLINDER INCIDENT: JUNE, 1983

20 minutes

Produced by the Hampton Fire Department, Video Documentation Unit

Traces the background of the two companies involved, and the slow development of realization that storage of a large quantity of gas cylinders in the midst of a residential neighborhood, and the sloppy disposal techniques of workmen moving the cylinders were building toward a potential disaster. Documents the process by which an incident command system was organized, and the local, state, and federal agencies whose personnel worked closely together to prevent the incident from escalating into catastrophe were combined into an effective and efficient work force. Analyzes the lessons learned from the experience and possible applications to future events.

Fire Chief Kenneth Lavoie of Hampton Virginia, an excellent speaker and supportive of community service, was responsible for the production of this tape and providing us a copy as well as giving of his time by discussing the topic.

ALL THE KINGS MEN

11 minutes

A vivid depiction of the Winchester tire fire which began October 31, 1983. Emphasizes the regional response team concept, and the efforts involved in coordinating more than 25 state, local and federal agencies plus numerous private firms. Primarily illustrates the Coast Guard Strike Response Force and how it over-saw and coordinated the fire. Included are some aspects of the Regional Response Team of Superfund but has limited discussions about the environmental impact.

Produced for the U.S. Coast Guard by the Public Information Assist Team. Also available from the Virginia State Water Control Board (Library), 2111 Hamilton Street, Richmond, VA 23219.

Consider having this tape and a speaker from the Virginia Office of Emergency and Energy Affairs reporting on their involvement and the related problems.

CONTRIBUTIONS OF PROJECTS TO MEETING STANDARDS OF LEARNING

SECTION III

The Dilemma Of Toxic Materials

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Contributions Of Projects To Meeting Standards Of Learning

As noted earlier in "Suggestions For Using This Guide", the instructional activities in Section I can be used to help meet a number of social studies and science expectations found in the Standards of Learning (SOL), established by the Virginia State Board of Education In this section you will find which activities address which SOL's.

Notice that many of the activities contribute to both science and social studies SOL's. The numbers, of course, identify specific standards in the respective SOL manuals for social studies and science.

Those numbers appearing in parentheses can be achieved with the particular activity if the teacher places emphasis upon them. Those without parentheses are the focus of that activity and thus would automatically be emphasized.

We wish to thank Alice L. Washington, faculty member of Charles City High School, Ruthville, Virginia, for her work on this section.

Curricular Topics	Suggested S.O.L. (s) for use with Social Studies and Science									
	Grades............Social Studies					Grades..............Science				
	6	7	8	9	10	6	7	8	9	10
1. Characteristics of A Toxic Substance						6.20	7.18	(8.1) 8.5 8.16		10.2
2. Water: A Civic Responsibility	(6.2)	(7.9)	8.7	(9.6) (9.11)	(10.5)	6.17 6.20	7.18	8.17		
3. Environmental Legislation: Benefits & Limitations			8.4 8.6	9.6		6.20	7.19	8.1 8.16 8.17	9.12	
4. Decision-Making: A Simulation	6.6	7.9	8.2 8.8	9.9 9.11 9.6	10.5 10.7 10.11	6.20	7.1 7.18 7.19	8.17		(10.12)
5. Vocabulary Reinforcement Exercises: Crosswords, Word Codings & Seek & Find				9.12						
6. Reading Skills, Media And Citizenship	6.6	7.7	8.8 8.10	9.6	10.11 10.13 10.12			8.1		

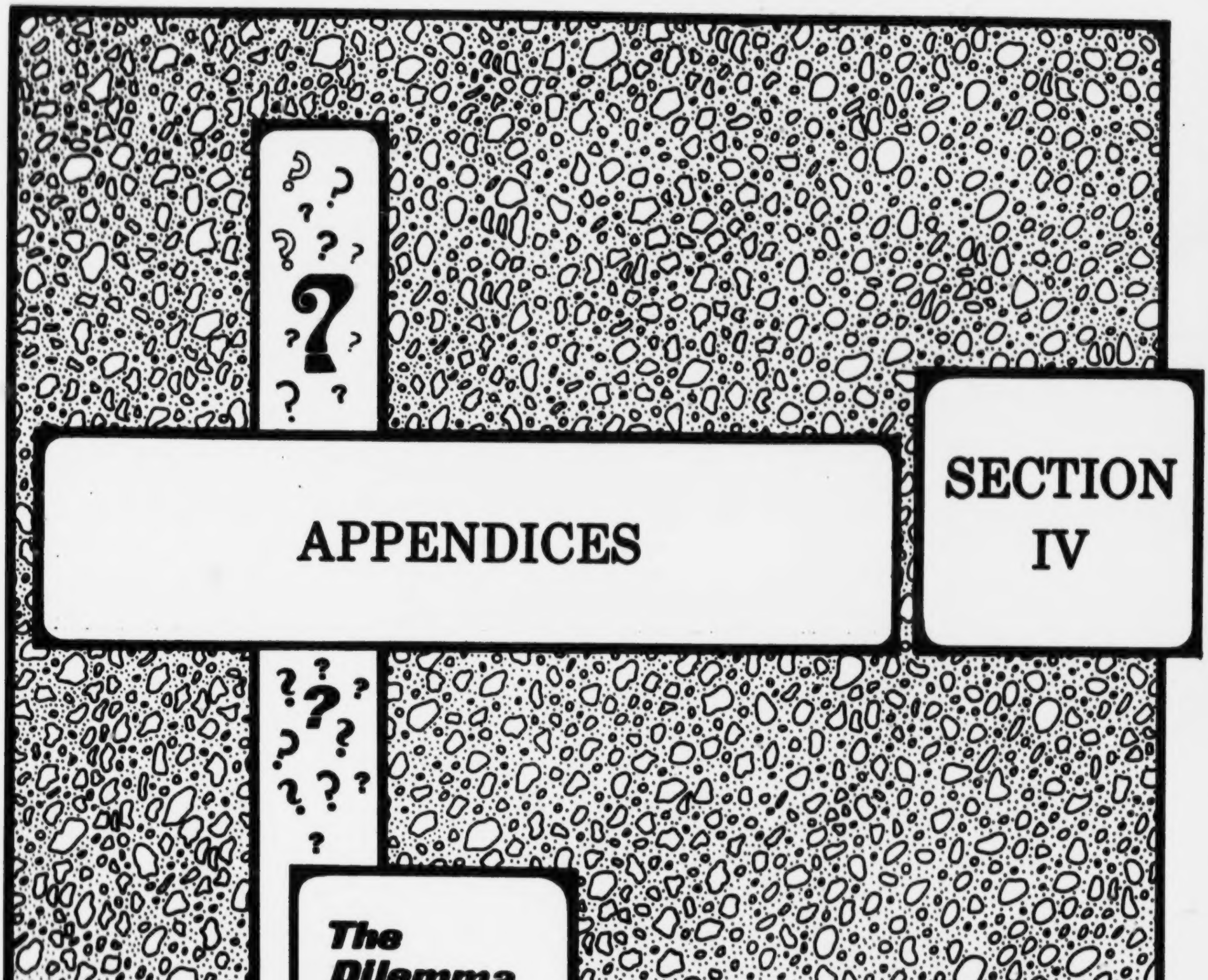
Curricular Topics	Suggested S.O.L. (s) for use with Social Studies and Science									
	Grades............Social Studies					Grades...............Science				
	6	7	8	9	10	6	7	8	9	10
7. Cartoons: Developing Analytical & Interpretive Skills	6.5	7.4 7.7	(8.8) 8.9	9.3 9.6	10.11		7.1 7.17	(8.1)		
8. Propaganda: Its Nature & Uses		7.7	8.8		10.11					
9. Getting the Lead Out: A Case Study	(6.2) (6.3)				10.5 10.12		7.18	(8.16) (8.17)		
10. River Pollution: Developing Geographic Understandings	(6.2) (6.3) (6.5) (6.6)	7.4		9.1 9.2 9.3 9.6 9.11	10.7 10.14	6.20 6.21	(7.19)	(8.16) 8.17	(9.10)	
11. Toxic Materials Instruction In United States History Courses	6.1 (6.2) (6.3) (6.8)	(7.1) (7.3) (7.6) 7.8	(8.3) (8.4) (8.6) (8.10)	(9.3) (9.4) (9.8) (9.9) (9.11)	10.1 10.5 10.10 10.11 10.12		(7.6) (7.20)	8.16 8.17		
12. The Vermiculite Asbestos Connection					10.5 10.7	(6.1)	(7.18) (7.20)	8.1 (8.2) (8.16) 8.17		10.12

Curricular Topics	Suggested S.O.L. (s) for use with Social Studies and Science									
	Grades............Social Studies					Grades..............Science				
	6	7	8	9	10	6	7	8	9	10
13. Skill Development in Studying Current Events	6.6	7.7	8.8 8.10	9.6	10.7 10.8 10.11 10.12			8.17		
14. Risk Versus Benefit: Pests & Pesticides in Your School	(6.2) 6.3	7.3 (7.9)	(8.7) 8.8	(9.6) (9.8) 9.9	10.5 10.11 10.13	6.2 6.6 6.20	(7.1) 7.15 7.18	8.16		
15. Land Use: Rights & Responsibilities	6.2 6.3 6.8 (6.9)	(7.2) 7.5 7.6	8.1 (8.2) 8.4 8.6	9.6 9.7 9.8 (9.9) 9.10 9.11	(10.5) 10.13	(6.21)	(7.18) (7.19)	(8.16)		
16. Waste: Comparing Past and Present Cultures	6.1 6.3 6.6 6.8	7.6 (7.10)	(8.1)	(9.4) 9.8 9.10	10.1 10.5 10.8			(8.16)		
17. Mercury Pollution & Simulated Production of Methyl Mercury						6.20 6.21	7.18 7.19	8.16 8.17		

Curricular Topics	Suggested S.O.L. (s) for use with Social Studies and Science									
	Grades............Social Studies					Grades..............Science				
	6	7	8	9	10	6	7	8	9	10
18. Legal Rights & Responsibilities	6.9	7.2 7.5 7.6	8.1 8.2 8.4 8.6 (8.8)							
19. Pesticides: Blessing or Curse? Including a Home Survey & Lable Study					(10.5)	6.20	(7.1) (7.5) 7.18	(8.1) (8.17) 8.16		(10.1) 10.2
20. Acid Runoff: A Case Study & pH/Oxidation Experiment	6.2 (6.3)			9.6	10.5	(6.1) (6.2) (6.6) 6.20 6.21	(7.1) (7.3) (7.5) (7.9) 7.19	(8.1) (8.5) (8.8) 8.16 8.17	9.9	10.1 10.2
21. Spirometry: Breathing, Lung Measurements, & Diseases						(6.2) (6.20)		(8.1) (8.3) (8.16) (8.17)		10.2
22. Hazardous Waste Sites & Virginia Geography	(6.3) (6.8)	7.4 (7.7) (7.8)	(8.8)	(9.1) 9.5 9.6 9.8 (9.9)	(10.5) 10.11					

Curricular Topics	Suggested S.O.L. (s) for use with Social Studies and Science									
	Grades............Social Studies					Grades..............Science				
	6	7	8	9	10	6	7	8	9	10
23. Transporting Hazardous Materials: A Serious Business	(6.2) (6.4) 6.5 (6.6) (6.18)	(7.4) (7.7) (7.8)	(8.1) (8.4) (8.8) 8.10	(9.3) (9.6) (9.9) 9.11	(10.5) (10.11)	(6.20)	(7.14)	(8.1) (8.5) (8.16) (8.17)		
24. A Demonstration of Groundwater Contamination In A Hazardous Waste Site Model	(6.2) (6.6)			(9.5) (9.6) (9.8) (9.11)		6.6 (6.20)	7.1	8.1 (8.5) 8.17	9.9	10.2
25. The Option of Waste Exchanges	(6.2) 6.3 6.6	(7.3) 7.7 (7.8) (7.10)	(8.8) 8.10	9.5 9.6 9.8 (9.9) (9.11) (9.12)	10.5 (10.10) (10.11) (10.12) (10.13)	(6.4) (6.20)	7.1 (7.5) (7.9) (7.14) (7.18) 7.19	8.1 8.5 (8.7) (8.8) 8.16 8.17 (8.18)		10.3
26. Acid Rain: A Basic Problem	6.3 (6.5) (6.6)	(7.3) (7.4) 7.7 (7.9)	8.8 (8.9) (8.10)	(9.1) (9.3) (9.5) (9.6) 9.8 (9.9) (9.11) (9.12)	10.5 (10.11) 10.13	6.1 6.2 (6.3) (6.5) (6.6) 6.20 (6.21)	7.1 (7.5) (7.9) (7.16) (7.18)	8.1 (8.2) 8.5 8.16 8.17	(9.2) (9.10) (9.19) 9.21	(10.1) 10.2 (10.3)

Curricular Topics	Suggested S.O.L. (s) for use with Social Studies and Science									
	Grades............Social Studies					Grades..............Science				
	6	7	8	9	10	6	7	8	9	10
27. Hang The Dumper: An Apple II Vocabulary Game		(7.3) (7.8)	(8.10)	(9.12)			(7.5)			



SECTION IV

APPENDICES

The Dilemma Of Toxic Materials

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Appendix 1

The Superfund and Other Major Toxic Substances Laws

Included herein is a summary of the Superfund Law as presented by the EPA as well as 18 other Major Federal Toxic Substances Laws. The latter are from The Toxic Substances Dilemna as published by the National Wildlife Federation.

THE SUPERFUND

Superfund was established by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, enacted in December 1980. The United States Environmental Protection Agency (EPA) is responsible for managing the Superfund program.

Until this law was passed, the Federal Government lacked the general authority to clean up hazardous waste sites or to respond to spills of hazardous substances onto land or into the air or non-navigable waters. Congress had addressed hazardous waste problems before, but Federal responsibilities were mostly regulatory. Congress therefore enacted new legislation to establish a five-year program to spearhead both Federal and State efforts to respond to releases of hazardous substances into the environment.

The Superfund law of December 1980-CERCLA-authorizes the Federal Government to respond directly to releases (or threatened releases) of hazardous substances and pollutants or contaminants that may endanger public health or welfare. Costs are to be covered by a $1.6 billion fund, 86 percent of which is financed by taxes on the manufacture or import of certain chemicals and petroleum, the remainder coming from general revenues. This fund is reimbursable: the government generally can take legal action to recover its clean-up costs from those subsequently identified as responsible for the release. Anyone liable for a release who fails to take ordered actions is (under specified conditions) liable for punitive damages equal to three times the government's response costs.

The guidelines and procedures that the Federal Government are following in implementing the Superfund law are spelled out in a flexible regulatory document called "The National Contingency Plan."

The Superfund program was built on the recognition that responses and clean-ups must be tailored to the specific needs of each site or each release of hazardous substances. EPA's strong enforcement effort seeks to ensure that private responsible parties finance clean-up actions when possible. Direct government action, when called for, can take the following forms:

> Immediate removals, when a prompt response is needed to prevent harm to public health or welfare or the environment. For example, immediate removals

may be ordered to avert fires or explosions, to prevent exposure to acutely toxic substances, or to protect a drinking water supply from contamination. Actions may include the installation of security fencing, the construction of physical barriers to control a discharge, or the removal of hazardous substances off the site. Ordinarily, immediate removals are limited by law to six months and a total cost of $1 million.

Planned removals, when an expedited, but not necessarily immediate, response is needed. These actions are intended to minimize increases in danger or exposure that would otherwise occur if response were delayed. Planned removals are subject to the same time and cost limits as immediate removals.

Remedial actions, which are longer-term and usually more expensive, are aimed at permanent remedies. They may be taken only at sites identified as national priorities. EPA published an interim list of national priority sites in October 1981; the list will eventually be expanded and continually updated. Specific actions may include the removal of drums containing wastes from the site, the installation of a clay "cap" over the site, the construction of ditches and dikes to control surface water or drains, liners, and grout "curtains" to control groundwater, the provision of an alternate water supply, or the temporary or permanent relocation of residents.

The primary responsibility for carrying out the Superfund program has been assigned by Executive Order to EPA. The Coast Guard, however, will respond to spills that occur in coastal areas. Other Federal agencies will provide assistance as necessary during a reponse. States are encouraged to take responsibility for an increasing number of Superfund-financed remedial actions. Under the law, State governments may plan and manage responses under agreement with the Federal Government. In remedial actions for which the Federal Government has lead responsibility, the Army Corps of Engineers will manage the design and construction stages for EPA. Private contractors will perform the work at a site under Federal or State government supervision.

An important part of the Superfund program is to encourage voluntary clean-up by private industries and individuals when they are responsible for releases. In fact, since the full extent of the problem has become understood, millions of dollars have been spent by industry for clean-up as well as for the retrofitting of existing facilities. Additionally, industrial research and development has resulted in significant advances in hazardous waste control technologies.

Working with the local community is a key aspect of every Superfund response. At each site, officials responsible for technical work will ensure that local citizens' and officials' concerns are taken into account in the development of solutions and that information about the site is widely distributed.

The $1.6 billion Superfund is large. However, the cost of responding to a hazardous substance release can be large too, and there are many sites and spills in need of attention.

Consequently, while CERCLA authorizes the government to respond to releases of hazardous substances, it does not require the government to respond to every release. At present, private parties handle about 90 percent of all releases that would otherwise require a removal action. In addition, CERCLA specifies that Superfund money can be spent only under carefully prescribed conditions.

A Superfund-financed response may not be taken if EPA determines that the owner, operator, or other responsible party is undertaking an appropriate cleanup.

Immediate removals are taken only to bring a release of hazardous substances under control, they are not intended to eliminate completely every long-term problem. As noted, both immediate and planned removals, usually must be limited in cost and duration.

Before a remedial action or planned removal can be taken, States must agree to pay 10 percent of project costs (at least 50 percent if the site was owned by the State or a local government). State governments must also agree to maintain the site after response work is completed and provide for off-site disposal if necessary.

Response under Superfund is not authorized in specified situations that may be covered by other laws (e.g. for certain releases of source, by product, or special nuclear material from a nuclear incident).

Because remedial actions may confront technically complex problems that are expensive to resolve, they are subject to further conditions. Technical measures can be selected only after evaluation of all feasible alternatives on the basis of economic, engineering, and environmental factors. The National Contingency Plan explains how to determine the extent of cleanup that is appropriate and most cost-effective for a particular site. In addition:

> The law requires that where ever possible, the remedy selected should avoid the costly step of excavating hazardous wastes and transporting them off the site for disposal elsewhere.
>
> The benefits to be derived from continued work at a remedial action site must be weighed against the benefits of working at other sites in the nation. A project could be delayed or terminated to allow funds to be shifted where they are most needed.

The intent of these conditions is to derive the maximum benefit from Superfund for the nation as a whole.

The Superfund program, in sum, is a coordinated effort of the Federal Government, State and local governments, private industry, and citizens. The problems are widespread and often will require time to resolve. But the Superfund program is a significant part of our national response to one of the major environmental challenges of the decade.

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Major Federal Toxic Substances Laws

1. **Atomic Energy Act of 1954**
2. **Clean Air Act**
3. **Clean Water Act of 1977**
4. **Consumer Product Safety Act of 1972**
5. **Federal Environmental Pesticide Control Act of 1972**
6. **Federal Hazardous Substances Act**
7. **Food, Drug and Cosmetic Act**
8. **Marine Protection, Research, and Sanctuaries Act of 1972**
9. **Occupational Safety and Health Act of 1970**
10. **Poison Prevention Act of 1970**
11. **Ports and Waterways Safety Act of 1972**
12. **Resource Conservation and Recovery Act of 1976**
13. **Safe Drinking Water Act**
14. **Toxic Substances Control Act**

15-18. Transportation of Toxic and Hazardous Substances (4 statutes)

1. Atomic Energy Act of 1954, as amended, Act of August 30, 1954, 68 Stat. 921, 42 U.S.C. §2011, *et seq.*

Synopsis:

A Nuclear Regulatory Commission license must be obtained for the processing, utilization, or distribution in interstate commerce of nuclear materials. The Food and Drug Administration's Bureau of Radiological Health regulates the uses of nuclear materials in the medical arts, and also regulates radioactivity levels in milk. The Environmental Protection Agency has responsibility for advising on environmental standards for radioactive materials, and for setting such standards for drinking water (under the Safe Drinking Water Act) and for ambient air and air emission sources (under the Clean Air Act).

2. Clean Air Act, Act of July 14, 1955, as amended, 69 Stat. 322, 91 Stat. 685, 91 Stat. 1399, 42 U.S.C. §7401, *et seq.*

Synopsis:

The Clean Air Act requires regulation of hazardous air pollutants from new or existing stationary or mobile sources. New source performance standards may also be imposed on hazardous air pollutants. The Act requires EPA to set general primary and secondary ambient air quality standards for which the states are required to submit implementation plans.

The Act embodies the Congressional finding that air pollution has resulted in mounting dangers to the public health and welfare, and includes the purpose of promoting the public health and welfare and the productive capacity of the Nation's population. (§7401).

States have the primary responsibility for assuring air quality within the entire geographic area comprising each State by submitting State-wide implementation plans which specify the manner in which national primary and secondary ambient air quality standards will be achieved and maintained within each air quality control region in a State. (§7407(a)).

Each State was required to submit to EPA (by mid-1978) for publication a list of those air quality control regions in the State which as of mid-1977 did not meet national primary and secondary ambient air quality standards, exceeded such standards, or could not be classified in terms of their ability to meet sulfur oxide and particulate levels. (§7407(d)).

The Administrator is required to publish and periodically update a list of air pollutants which "may reasonably be anticipated to endanger public health or welfare." He must then issue "air quality criteria" for each of these pollutants which accurately reflect the latest scientific knowledge regarding the kind and extent of all identifiable effects of the pollutants on public health or welfare. At the same time, the Administrator is required to issue information on air pollution control techniques, including available data on "available technology" and alternative methods of prevention and control of air pollution. The issuance of air quality criteria and information on control techniques is required to be announced in the Federal Register with copies to be made available to the general public. (§§7408(a)-(d)).

EPA is required to publish regulations prescribing national primary and secondary ambient air quality standards for each air pollutant for which air quality criteria have been issued. The primary standards must be such as are requisite to protect the public health (allowing an adequate margin of safety). Secondary standards must be such as to protect the public welfare from any known or anticipated adverse effects associated with the air pollutants in question. (§§§7409(a),(b)).

The States are required to adopt and submit for EPA approval implementation plans for meeting and enforcing national primary and secondary ambient air quality standards. (§7410(a)).

The Administrator is required to publish a list of categories of stationary sources which contribute significantly to air pollution and may reasonably be anticipated to endanger public health or welfare. Federal standards of performance for new sources within each such category must then be promulgated. Implementation and enforcement of these standards of performance must be delegated to qualified States, although EPA retains concurrent enforcement authority. The Administrator is required to promulgate regulations providing for States to submit implementation plans for applying standards of performance to air pollutants produced by existing sources within the categories covered by the new source standards, for which air quality criteria have not been issued. (§7411).

The Administrator is required to publish a list of hazardous air pollutants, for which he must then establish emission standards. A "hazardous air pollutant" is one for which there is no applicable ambient air quality standard and which in the Administrator's judgment contributes to air pollution which "may reasonably be anticipated to result in an increase in mortality or an increase in serious irreversible,

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or incapacitating reversible, illness." Once an emission standard becomes effective for a hazardous air pollutant, no new source may be constructed or existing source modified which will cause the standard to be exceeded. Nor may any air pollutant be emitted from any stationary source in violation of the standard. Implementation and enforcement are to be delegated to qualified States, with concurrent enforcement authority retained by EPA. (§§7412(a)-(d)).

Any records, reports or information obtained from emission sources by the Administrator must be available to the public, except upon a showing that public release would divulge trade secrets or confidential information. (§ 7414(c)).

The Administrator is required to review all available relevant information and determine whether or not emissions of radioactive pollutants, cadmium, arsenic and polyclic organic matter will contribute to air pollution which may reasonably be anticipated to endanger public health. Substances for which the Administrator makes an affirmative determination must then be included on the hazardous air pollutant list and/or on the list of categories of new sources. (§ 7422).

State implementation plans must contain effective measures for notifying the public on a regular basis of instances or areas in which any national primary ambient air quality standard was exceeded, including advising the public of the health hazards associated with such pollution. (§ 7427).

Upon receipt of evidence that a pollution source is presenting an imminent and substantial endangerment to the health of persons, and that a State and local officials have not acted to abate it, the Administrator is authorized to bring a civil suit to immediately restrain the emission, or to issue necessary emergency orders to assure prompt protection of human health. (§ 7603).

Citizen suits are authorized against violators of emission standards and limits, against the Administrator for failure to perform any non-discretionary act or duty, and against the proposed construction of any new or modified major emitting facility without a required permit or in violation of applicable permit conditions. (§ 7604).

Federal agencies are prohibited from entering into contracts with anyone convicted of violating implementation plan requirements, etc. (§ 7606).

3. Clean Water Act of 1977, Act of October 18, 1972, as amended, 86 Stat. 816, 91 Stat. 1566 , 33 U.S.C. § 1251, *et seq.*

Synopsis:

The Clean Water Act of 1977 ("CWA") is a lengthy and complex statute. The "Committee Print" of the statute takes up 125 pages. It is, however, an extremely important statute from the standpoint of toxic substances control.

Section 101(a) of the CWA states the Act's objective as being "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Among the goals and policies announced to promote this objective are: a national goal of eliminating "the discharge of pollutants into the navigable waters" by 1985 (§ 101(a)(1)); a national goal of attaining an interim goal of fishable and swimmable waters by July 1, 1983 (§ 101(a)(2)); a national policy of prohibiting "the discharge of toxic pollutants in toxic amounts" (§ 101(a)(3)); and a national policy of making a major research and demonstration effort "to develop technology necessary to eliminate the discharge of pollutants into the navigable waters, waters of the contiguous zone, and the oceans" (§ 101(a)(6)).

The CWA also emphasizes, in very strong language, the importance of promoting public participation in CWA programs. Section 101(e) directs the EPA Administrator and the States to provide for, encourage, and assist public participation "in the development, revision, and enforcement of any regulation, standard, effluent limitation, plan, or program" established under the Act.

Section 301(a) prohibits the discharge of any pollutant without a permit under Section 402, and except in compliance with technology-based effluent limitations under Section 301, water-quality-related effluent limitations under Section 302, new source performance standards under Section 306, and toxic and pretreatment effluent standards under Section 307.

Section 301(b)(1)(A) requires all discrete ("point source") dischargers (other than publicly owned treatment works—"POTW's") to apply "best practicable control technology currently available" ("BPT"), as defined under Section 304(b). This requirement is limited, however, to facilities discharging directly into a waterway. "Indirect dischargers"—those that discharge via a POTW rather than directly into a waterway must satisfy applicable pretreatment and toxic control requirements under Section 307. Dischargers must also meet any more stringent requirements under applicable water quality standards or under any other applicable State or Federal law or regulation (§ 301(b)(1)(C)).

Section 301(b)(2)(A) requires direct discharging point sources to apply "best available technology economically achievable" ("BAT") within their industry category or class, which "will result in reasonable further progress toward the national goal of eliminating the discharge of all pollutants," and which will eliminate discharges of all pollutants if such elimination is technologically and economically achievable. Indirect dischargers must comply with any applicable pretreatment and toxic requirements under Section 307. Compliance must be achieved by July 1, 1984, for 65 specified toxic pollutants (the so-called "Consent Decree" pollutants.)(§ 301(b)(2)(C)); within 3 years from the establishment of effluent limitations for other toxic pollutants under § 307(a)(1))(§ 301(b)(2)(D)); and by July 1, 1987, at the latest, for all other pollutants (§ 301(b)(2)(F)).

Section 303 provides for the establishment of water quality standards for interstate and intrastate waters. Revised or new standards must protect the public health or welfare, enhance the quality of water and serve the purposes of the Act.

Section 304(b) requires the Administrator to publish effluent limitation guidelines defining BPT and BAT for classes and categories of point sources. Section 304(e) gives the Administrator the discretion to publish regulations establishing effluent controls supplementary to BPT and BAT requirements for "any specific pollutant which the Administrator is charged with a duty to regulate as a toxic or hazardous pollutant under section 307(a)(1) or 311," in order to control sludge or waste disposal, etc., which the Administrator determines "may contribute significant amounts of such pollutants to navigable waters." Section 304(g)(1) requires the Administrator to publish guidelines for the pretreatment of pollutants which are not susceptible to treatment by POTW's. And Section 304(h) requires the Administrator to promulgate guidelines establishing test procedures for the analysis of pollutants.

Section 306 requires the Administrator to establish new source performance standards, prescribing BAT-level controls, for categories of point sources.

Section 307(a)(1) establishes a toxic substances list, initially containing 65 groups of specific chemicals, which the Administrator is authorized to revise periodically, taking into account various factors, including the toxicity of the pollutant, its persistence, degradability, and its impacts on affected organisms in any waters. Section 307(b)(2) requires the Administrator to establish "effluent limitations" based upon BAT for each listed toxic pollutant for the applicable category or class of point sources. In addition, the Administrator may publish more stringent toxicity-oriented "effluent standards" or prohibitions. (§ 307(a)(3)).

Effluent standards must provide an "ample margin of safety" and must be applied to specified categories of sources (§§ 307(a)(4),(5)).

Section 307(b)(1) requires the Administrator to establish "pretreatment standards" for pollutants which are discharged into POTW's and which are determined not to be susceptible to treatment or to interfere with the operation of the treatment works. These standards must specify a time for compliance of not more than three years and must be designed to prevent the discharge of incompatible pollutants through the treatment works. (§§ 307(b)(2),(3)).

Section 307(c) requires the Administrator to promulgate pretreatment standards for "new source" indirect dischargers. These pretreatment standards must prevent the discharge of incompatible pollutants into the POTW. Section 307(d) makes it unlawful for a discharge to take place in violation of any applicable effluent standard or prohibition or pretreatment standard.

Section 308 directs the Administrator to require dischargers to establish and maintain records and other information necessary to carry out the Act's objectives. Effluent data must be related to applicable effluent limitations and must be made available to the public, subject to specified "trade secret" exceptions.

Section 309 provides for Federal enforcement of the conditions and limitations implementing §§ 301, 302, 306, 307, 308, 318, 402, 404, and 405 of the Act. The Administrator may issue compliance orders giving dischargers a specified amount of time to correct violations. He may commence civil actions, either to enforce compliance orders, or to enjoin violations and secure other appropriate relief. And he may initiate criminal action against any person who "willfully or negligently" violates §§ 301, 302, 306, 307, 308, 402, or 405 of the Act.

Section 311(b)(2)(A) requires the Administrator to develop and publish regulations designating as "hazardous substances," those elements and compounds (other than oil) which, when discharged in any quantity into U.S. waters or on adjoining shorelines, "present an imminent and substantial danger to the public health or welfare, including, but not limited to, fish, shellfish, wildlife, shorelines, and beaches." (§ 311(b)(2)(B)(i)). The Administrator is empowered to act to mitigate the damage caused to public health and welfare, by the discharge, with the cost of such mitigation being added to the removal costs assessed against the dischargers (§ 311(b)(2)(B)(iv)). Section 311(b)(3) prohibits the discharge of oil or hazardous substances into U.S. waters or on shorelines "in harmful quantities." "[T]hose quantities of oil and any hazardous substance the discharge of which, at such times, locations, circumstances, and conditions, will be harmful to the public health or welfare of the United States" is to be established by regulation by the President, under § 311(b)(4). Section 311(c)(1) authorizes the President to act to remove oil or a hazardous substance at any time whenever these materials are discharged, or there is a "substantial threat" of such discharge, into or upon U.S. waters or shorelines.

Section 313 requires Federal facilities to comply with all Federal, State, interstate, and local requirements concerning the control and abatement of water pollution "in the same manner, and to the same extent" as any nongovernmental entity. The President is, however, authorized to provide one-year exemptions for Executive Branch effluent sources where he determines it to be "in the paramount interest of the United States," except that the requirements of §§ 306 and 307 are non-waivable.

Section 402 is, in many respects, the cornerstone of the Clean Water Act. It establishes a permit system for regulating all pollutant discharges (with a few exceptions) into navigable waters. This permit system is known as the "National Pollutant Discharge Elimination System," with permits commonly referred to as "NPDES" permits. Section 402(a)(1) authorizes the Administrator to issue an NPDES permit for the discharge of any pollutant (after "opportunity for public hearing"), upon condition that the discharge will meet all applicable requirements under §§ 301, 302, 306, 307, 308, and 403 of the Act. Section 402(a)(2) requires the Administrator to prescribe permit conditions necessary to comply with the requirements of paragraph (a)(1), "including conditions on data and information collection, reporting," and other appropriate requirements. Section 402(a)(3) requires EPA's permit program to apply the same terms, conditions, and requirement as apply to a State permit program.

Section 402(a)(5) requires the Administrator to delegate permit-issuing responsibility for navigable waters within their jurisdiction to States which he determines have the capability of administering a permit program which will carry out the Act's objectives. The Administrator retains the right, however, to impose necessary conditions on such permits, and no NPDES permit may be issued by a State if the Administrator objects to its issuance. Section 402(b) sets forth the necessary components of an approvable State program (which must also be applied by EPA's permit program). Among these components is adequate authority to insure that any permit for a discharge from a POTW includes conditions to require identification of the character and volume of pollutants from any significant industrial source which is subject to § 307(b), and a program to assure compliance with pretreatment standards by each source. The permit must also require adequate notice to the permitting agency of information on the quality and quantity of effluent to be introduced into the POTW. State-issued permits, moreover, must insure that any industrial user of a POTW will comply with § 307 and certain other provisions.

Section 402(c)(2) requires any State NPDES program to be at all times in compliance with § 402, and the Administrator is required to withdraw approval from a State program, under § 402(c)(3), whenever he determines that the program is not being administered in accordance with § 402 requirements, if appropriate corrective action is not taken.

Section 402(j) expressly requires copies of "each permit application and each permit issued under this section" to be made available to the public.

Section 402(k) makes compliance with an NPDES permit automatic compliance with §§ 301, 302, 306, 307, and 403, but not necessarily with standards imposed under § 307 for a toxic pollutant injurious to human health.

Section 504 authorizes the Administrator to bring suit to immediately restrain the discharge of pollutants from any source or combination of sources upon receipt of evidence that the discharge is presenting "an imminent and substantial endangerment to the health of persons" or to the livelihood of persons. The Administrator is also authorized to provide emergency assistance, including application of measures to abate and remedy the emergency and the performance of research on the effects of an emergency on health and the environment.

Section 505 is a "Citizen Suit" provision. It authorizes any citizen, in addition to otherwise available remedies, to bring a citizen, in civil suit against any violator of an effluent standard or limitation or of a duly issued compliance order. The citizen may also sue the Administrator for failing to perform any nondiscretionary act or duty. Before a citizen suit may be brought under this provision, however, the plaintiff must give sixty days' advance notice of the alleged violation to the Administrator, to the State in which the violation occurred, and to any alleged violator. This notice is intended to provide the alleged violator with a last opportunity to voluntarily correct the violation. It may also give EPA or a State the opportunity to initiate enforcement action on their own (in which case, the citizen may still intervene in the case as a matter of right). Courts are empowered, in ruling on a citizen suit, to award costs of litigation to any party, whenever appropriate.

Finally, among various miscellaneous provisions in the Act, § 508(a) bars Federal agencies from entering into contracts with persons who have been convicted of offenses under § 309—at least if the contract is to be performed at the facility at which the violation occurred, and if the facility is owned, leased, or supervised by the person convicted. The threat of lost government contracts can sometimes be a more powerful prod to compliance with pollution laws than the fear of incurring a modest civil or criminal penalty.

4. Consumer Product Safety Act of 1972, Act of October 27, 1972, 86 Stat. 1207, as amended by the CONSUMER PRODUCT SAFETY COMMISSION IMPROVEMENTS ACT OF 1976, Act of May 11, 1976, 90 Stat. 503, as amended by the EMERGENCY INTERIM CONSUMER PRODUCT SAFETY STANDARD ACT OF 1978, Act of July 11, 1978, 92 Stat. 386, 15 U.S.C. § 2051, *et seq.*

Synopsis:

The Act authorizes the Consumer Product Safety Commission to set standards regulating the performance, composition, content, design, construction, packaging, or labeling of consumer products. Where no feasible safety standard can adequately protect the public, the Commission may totally ban the product. The Act encompasses any article or component, produced or distributed for sale to consumers for use in or around a household or residence, school, or for recreational purposes. The term "consumer product" excludes tobacco products, motor vehicles, pesticides, boats, aircraft, and food, drug, and cosmetic items. It does, however, include such things as aluminum branch circuit wiring in a home and amusement park rides (as long as the associated risks do not threaten only employees). Any interested consumer may petition the Commission to issue, amend, or revoke a consumer product safety rule.

5. Federal Environmental Pesticide Control Act of 1972, Act of June 25, 1947, as amended, 86 Stat. 975, 87 Stat. 903, 89 Stat. 754, 7 U.S.C. § 321, *et seq.*

Synopsis:

Requires all formulators and producers of pesticides to have their products and establishments registered with EPA on the basis of submitted safety data. Prohibits the sale, distribution and use of pesticides except in accordance with registered labels.

Covered "pesticides" include (1) substances (other than antibiotics) intended for destroying or repelling any "pest" (defined to include organisms ranging from viruses and bacteria to rodents), and (2) substances intended for use as a plant regulator or destroyer. Excludes "new animal drugs" and "animal feeds." (§ 136(u)).

Prohibits, subject to specified exceptions, the distribution, sale, advertisement, shipment, and delivery of any pesticide which is not registered with the EPA Administrator. (§ 136a(a)).

Applications for registration of a pesticide must include a statement which includes the name of the pesticide, its complete chemical formula, and a complete copy of the labeling of the pesticide. (§ 136a(c)(1)).

The Administrator is required to publish, and periodically revise, guidelines specifying the kinds of information which will be required to support the registration of the pesticide. Subject to trade secret exclusions, the Administrator must make available to the public within 30 days after registering a pesticide the data called for in the registration statement, together with other relevant scientific information. (§ 136a(c)(2)).

The Administrator is required to promptly publish a notice in the Federal Register of each application for registration of a pesticide if it contains any new active ingredient or would entail a changed use pattern. Interested persons must be allowed 30 days in which to comment. (§ 135a(c)(4)).

Registration of a pesticide must be approved if the Administrator determines that the claims proposed for a pesticide are warranted by its composition, that labeling and application requirements have been met, that the pesticide will perform its intended function without "unreasonable adverse effects on the environment," and that the pesticide, when used in accordance with widespread and commonly recognized practice, will not generally cause "unreasonable adverse effects on the environment." (§ 136a(c)(5)). If these requirements are not met, the Administrator must inform the applicant; he may refuse to register the pesticide if the applicant does not correct the conditions within 30 days. (§ 136a(c)(6)).

In registering a pesticide, the Administrator must classify it for either general use (if it will not cause unreasonable adverse effects on the environment) or for restricted use (if it may cause such effects without additional regulatory restrictions). (§ 136a(d)).

The Administrator may grant an "experimental use permit" for a pesticide if he determines that the applicant needs a permit of this kind in order to accumulate information necessary to register a pesticide. He may establish a "temporary tolerance level" for the pesticide if he determines that it may reasonably be expected to result in any residue on or in food or feed. (§ 136c(a),(b)).

The Administrator is required to cancel the registration of any pesticide at the end of five years unless the registrant seeks continuation of the registration before the end of this period. (§ 136d(a)(1)).

After a pesticide has been registered, if the registrant has "additional factual information" regarding "unreasonable adverse effects" of the pesticide on the environment, he must submit this information to the Administrator. (§ 136d(a)(2)).

The Administrator may issue a notice of his intent either (1) to cancel a pesticide's registration or to change its classification, or (2) to hold a hearing to determine whether or not its registration should be canceled or its classification changed, if it appears to him that a pesticide or its labeling or required submissions do not comply with the Act's requirements. If the Administrator determines that suspension of a pesticide registration is necessary to prevent an "imminent hazard to human health," the proposed action becomes final and effective at the end of 30 days from publication or receipt of the notice announcing this action. Otherwise, the Secretary of Agriculture must first be given 30 days in which to respond to the proposal. (§ 136d(b)).

Details of the procedure for suspending the registration of a pesticide to prevent an imminent hazard are set forth in § 136d(c).

Establishments which produce any covered pesticide must register with EPA. The registration statement must contain information on the types and amounts of pesticides currently produced (and produced, sold and distributed during the past year). This information is to be considered confidential and subject to trade secret requirements. (§ 136e).

Section 136h provides for protection of trade secrets and privileged or confidential information.

It is unlawful to detach, alter or destroy any required labeling of a pesticide; to use any registered pesticide in a manner inconsistent with its labeling; and to add any substance to, or take any substance from, any pesticide in a manner that may defeat the Act's purposes. (§ 136j(a)).

The Administrator is required, after consultation with other interested Federal agencies, to establish procedures and regulations for the disposal or storage of packages and containers of pesticides and accept at convenient locations for safe disposal a pesticide the registration of which is canceled if requested by the owner of the pesticide. (§ 136q).

Enforcement and judicial review procedures, and applicable civil and criminal penalties, are set forth in Sections 136g(c), 136n, and 136*l*.

6. Federal Hazardous Substances Act, Act of July 12, 1960, 74 Stat. 372, as repeatedly amended (most recently in 1976), 15 U.S.C. § 1261, *et seq.*

Synopsis:

The Act prohibits the introduction into interstate commerce of any "misbranded hazardous substance" or "banned hazardous substance." It also prohibits the introduction into interstate commerce of a "hazardous substance" in a reused food, drug, or cosmetic container, or in a container labelled or identified as a food, drug, or cosmetic container. Hazardous substances are toxic, corrosive, and other dangerous articles intended for or accessible to use by children, including articles suitable for household use. They are considered "misbranded" if such articles fail to bear prominent warning labels. They are "banned" if the Commissioner of the Consumer Product Safety Commission determines they are so inherently dangerous that the health and safety of the public can be adequately assured only by keeping them off the market.

7. Food, Drug and Cosmetic Act, Act of June 25, 1938, 52 Stat. 1040, as repeatedly amended, 21 U.S.C. § 301.

Synopsis:

The Act prohibits the introduction in commerce of "adulterated" or misbranded foods, drugs, devices, or cosmetics (§ 331).

A food is considered adulterated if it contains any harmful ("poisonous or deleterious") substance (whether added or not) which may make it injurious to health, or which is "unsafe" (§ 342(a)(1)).

Any harmful substance added to any food, except where required in food production or unavoidable by good manufacturing process, is deemed unsafe (§ 346).

Any harmful pesticide chemical, or any pesticide chemical which is not "generally recognized . . . as safe" for use (i.e., on a "GRAS" list), and which is added to a raw agricultural commodity, is deemed unsafe unless the pesticide level in the commodity is within tolerance limits prescribed by the EPA Administrator (§ 34).

A food additive is considered unsafe unless (1) it is being used in accordance with the terms of an applicable exemption, or (2) it is being used in accordance with a regulation prescribing the conditions under which it may be safely used (§ 348(a)).

"Food additive" is defined as any substance the intended use of which may result in its becoming a component of or otherwise affecting the characteristics of any food, unless the substance is generally recognized as safe (§ 321(s)).

The HEW Secretary may establish regulations prescribing the conditions under which a food additive may be safely used. He may do so, either on his own initiative, or in response to a petition by any person. No regulation may issue, however, if a fair evaluation of the data fails to establish that the proposed use of the food additive will be safe. No additive may be deemed safe if it is found to induce cancer when ingested by man or animal [Delaney Clause] (§ 348(b), (c)).

8. Marine Protection, Research, and Sanctuaries Act of 1972, Act of October 23, 1972, as amended, 86 Stat. 1052, 88 Stat. 50, 91 Stat. 1255, 33 U.S.C. § 1401, *et seq.*

Synopsis:

This Act, popularly known as the "Ocean Dumping Law", consists of three parts or "titles". Only Title I will be summarized here, since Title II describes the research program of the National Oceanic & Atmospheric Administration and Title III concerns the establishment of "marine sanctuaries."

The Ocean Dumping Law is structured around a permit program which regulates all materials transported out of a U.S. port or on a U.S. vessel for the purpose of disposal at sea. In recent years, the Act's application has been extended to the at-sea incineration of industrial wastes aboard specially designed incinerator ships. The Act covers all ocean dumping under U.S. jurisdiction as defined above, no matter how far out to sea.

The Act allows the EPA Administrator to issue an ocean dumping permit for the disposal of industrial and municipal wastes, or approve the use of an ocean location as a disposal site, only in accordance with ocean dumping criteria established by EPA. The criteria are required to reflect nine specified evaluation factors, including the need for and availability of alternatives to the proposed dumping, the feasibility of utilizing dumpsites off the edge of the Continental Shelf, and a variety of factors relating to the effects of the dumping on human health and welfare and on marine ecosystems.

Ultimately, an ocean dumping permit may be issued only where the Administrator determines that the proposed dumping "will not unreasonably degrade or endanger human health, welfare, or amenities, or the marine environment, ecological systems, or economic potentialities." (§ 102-(a)). All permit actions must be preceded by public notice and an opportunity for public hearing. The Act expressly requires all information received by EPA as part of any ocean dumping permit application or in connection with any permit granted under the ocean dumping law to "be available to the public as a matter of public record, at every stage of the proceeding." (§ 104(f)).

As is true for most of the other Federal environmental statutes, the ocean dumping law contains a "Citizen Suit" provision, requiring the usual 60-days' advance notice, and allowing the reviewing court to award either party "costs of litigation," including reasonable attorney and expert witness fees. (§ 105(g)).

9. Occupational Safety and Health Act of 1970, Act of Dec. 29, 1970, 84 Stat. 1590, 29 U.S.C. § 651, *et seq.*

Synopsis:

The Act requires employers to furnish workers employment conditions free from recognized hazards that are likely to cause death or serious physical harm (§ 654(a)(1)).

Employers must comply with the safety and health standards established under this Act (§ 654(a)(2)).

The Secretary of Labor is authorized to establish occupational safety and health standards, after notice of proposed rulemaking and an opportunity for *public comment* (§ 655(a), (b)).

Standards dealing with "toxic materials" or "harmful physical agents" should be those which most adequately assure that no employee will suffer material impairment of health or functional capacity even if the employee is regularly exposed to the hazard throughout his working life. Whenever practicable, the standard must be expressed in terms of "objective criteria" and of "the performance desired." (§ 655(b)(5)).

Standards must prescribe use of appropriate warning labels and devices and, where appropriate, suitable protective equipment, control procedures, monitoring of employee exposure, and periodic medical examinations of employees (§ 655(b)(7)).

Emergency temporary standards, effective immediately for up to 6 months, must be established where the Secretary determines they are necessary because employees are exposed to "grave danger" from exposure to "toxic" or physically harmful substances or agents or to "new hazards." (§ 655(c)).

Affected employees must be given an opportunity to participate in hearings on employer requests for variances from established health and safety standards (§ 655(d)).

Employers must keep records as prescribed by the Secretary of Labor in cooperation with the Secretary of HEW, as necessary or appropriate for developing information regarding the causes and prevention of occupational accidents and illnesses (§ 657(c)(1)).

The Secretary must require employers to maintain accurate records of employee exposures to potentially toxic materials or harmful physical agents which must be monitored or measured under § 655 of the Act. Employees must have access to these records and they must be promptly notified of any exposure to these agents in excess of applicable standards (§ 657(c)(3)).

Any employees or employee representatives may, by written notice to the Secretary of Labor, request a special inspection of a workplace where they believe a violation of a safety or health standard exists that threatens physical harm, or that an imminent danger exists. If the Secretary determines that there are reasonable grounds to believe that such a violation or danger exists, he must make a special inspection as soon as possible (§ 657(f)(1)).

The Act prohibits reprisals against employees for exercising rights under the Act (§ 660(c)).

The Act provides for issuance of "citations" and "notices in lieu of citations" against violators (§ 658), for enforcement of citations before an Occupational Health and Safety Review Commission (§ 659), for judicial review and enforcement of Commission orders (§ 660), for injunctive relief (§ 662), and for imposition of civil and criminal penalties (§ 666).

10. Poison Prevention Act of 1970, Act of Dec. 30, 1970, as amended, 86 Stat. 998, 15 U.S.C. § 1471.

Synopsis:

The Act requires special packaging of certain "household substances" which may pose a hazard to children.

"Household substances" covered include:

(1) "hazardous substances" (as defined in the Federal Hazardous Substances Act, 15 U.S.C. § 1261(f)), such as toxic, corrosive, and flammable substances and mixtures which may cause substantial personal injury as a result of reasonably foreseeable handling or use, and any article intended for use by children which presents an electrical, mechanical, or thermal hazard;

(2) "pesticides" (as defined in the Federal Environmental Pesticide Control Act of 1972, 7 U.S.C. § 136(u));

(3) "foods," "drugs," and "cosmetics" (as defined in the Federal Food, Drug and Cosmetic Act, 21 U.S.C. § 321); and

(4) containerized fuels used in home heating, cooking, or refrigeration systems (§ 1471(2)).

The Secretary of HEW is authorized to set standards for the special packaging of a household substance if he finds it necessary in order to protect children from serious personal injury or illness, and finds the standards to be feasible, practicable, and appropriate for the substance. (§ 1472(a)).

Special packaging standards are to be established after notice of proposed rulemaking and opportunity for public comment (§ 1474(a)).

Whenever a packaging standard has been established under this Act, no state or locality may impose differing standards. (§ 1476).

11. Ports and Waterways Safety Act of 1972, Act of July 10, 1972, 86 Stat. 424, 33 U.S.C. § 1221, *et seq.*

Synopsis:

Title II of the Act requires the Secretary of Transportation (through the U.S. Coast Guard) to establish rules and regulations aimed at preventing or mitigating damage to the marine environment associated with vessels carrying liquid cargo that is flammable or combustible, oil, or a hazardous polluting substance. These regulations specify minimum standards of design, construction, alteration, repair, maintenance, and operation for such vessels.

12. Resource Conservation and Recovery Act of 1976, Act of October 21, 1976, 90 Stat. 2795, 42 U.S.C. § 6901, *et seq.*

RCRA was built on the foundation of the Solid Waste Disposal Act of 1965 and the Resource Recovery Act of 1970 in the face of a growing solid waste disposal problem. Among other provisions, the legislation establishes a permit program to manage potentially hazardous materials from their point of origin to their point of ultimate disposal; from "cradle to grave," as it were.

The Act is subdivided into nine subtitles, including Subtitle C dealing with "Hazardous Waste Management." The major provisions applicable to toxic substances control can be summarized as follows:

Subtitle A sets forth the congressional findings that the disposal of "hazardous waste" on the land can present a danger to human health and the environment if done without careful planning and management, and that hazardous waste presents special dangers to health and requires a greater degree of regulation than does non-hazardous solid waste (§ 1002(b)). "Solid waste" is defined broadly to include any discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities—subject to several specified exceptions (§ 1004(27)). "Hazardous waste" is a category of solid waste which, because of quantity, concentration, or physical, chemical, or infectious characteristics may contribute to an increase in mortality or serious illness, or may pose a substantial hazard to human health or the environment when improperly managed (§ 1004(5)). Subtitle A directs the EPA Administrator to publish guidelines on solid waste management to be used by the States for determining compliance with Subtitle C controls on hazardous waste management (§ 1008(a)). The subtitle also encourages the integration of RCRA with other statutes, and prohibits the inconsistent application of RCRA to activities or substances subject to other Acts (§ 1006).

Subtitle B establishes an Office of Solid Waste within EPA (headed by a Deputy Assistant Administrator) to oversee the implementation of the Act's hazardous waste and other provisions (§ 2001). This office is the focal point for consultations with representatives of the public (§ 2002(a)(4)).

EPA is required to use at least 30% of the funds appropriated under the Act solely for carrying out §§ 3002 through 3011 of subtitle C, relating to hazardous wastes (§ 2006(c)).

One of the primary thrusts of RCRA is to impose new requirements on the management of hazardous wastes. These are contained in Subtitle C.

The Administrator is required to promulgate *criteria* for identifying the characteristics of hazardous waste, and for listing hazardous waste which should be subject to subtitle C. In doing so, he must take account of such factors as toxicity, potential for accumulation in tissue and other hazardous characteristics. He must also promulgate *regulations* identifying the characteristics of hazardous waste, and listing particular hazardous wastes subject to subtitle C, based on the previously established criteria. The Governor of any State may also petition to have any material identified or listed as a hazardous waste, and the Administrator must respond with 90 days (§ 3001).

The Administrator is required to promulgate standards applicable to hazardous waste *generators* which establish requirements regarding recordkeeping practices, labeling practices, use of appropriate containers, furnishing of information on the general chemical composition of a hazardous waste to those who transport, treat, store or dispose of it, use of a manifest system, and submission of reports to the Administrator or an authorized State agency. (§ 3002).

The Administrator is required to promulgate standards applicable to hazardous waste *transporters*, which must include at minimum recordkeeping, labeling, and manifest use requirements, and which require hazardous waste to be transported only to treatment, storage, or disposal facilities which the shipper designates on the manifest to be holders of a Subtitle C permit. For any hazardous waste which is subject to the Hazardous Materials Transportation Act, 49 U.S.C. § 1801, *et seq.*, the standards must be consistent with that Act and its implementing regulations (§ 3003).

The Administrator is also required to promulgate regulations establishing performance standards applicable to *owners and operators* of hazardous waste treatment, storage and disposal facilities. Such standards must require recordkeeping; reporting, monitoring, inspection, and compliance with the manifest system; transportation, storage, and disposal in accordance with satisfactory operating methods, techniques, and practices; compliance with criteria for the location, design, and construction of treatment, storage and disposal facilities; contingency plans to minimize unanticipated damage; owner and operator performance standards; and compliance with § 3005 permit requirements (§ 3004).

In addition, the Administrator is required to promulgate regulations requiring *owners and operators* of treatment, storage and disposal facilities, to have a subtitle C permit. These regulations become effective 6 months after promulgation; thereafter, hazardous waste disposal is prohibited except in accordance with such a permit (§ 3005(a)). Permit applications must include estimates of the material's composition, quantities, and concentration; and the site at which it will be processed, disposed of or stored (§ 3005(b)). A permit *must* be issued, if the Administrator (or an authorized State) determines that §§ 3004 and 3005 have been complied with. If modifications are necessary, the permit must specify the time allowed to complete the modifications (§ 3005(c)). The permit *must* be revoked upon a determination of noncompliance with § 3004 or § 3005(d)). A permit applicant will be treated as though he had a permit, if the facility to be permitted was "in existence" as of October 21, 1976, and § 3010(a) (relating to preliminary notification) has been complied with—unless the delay in obtaining a permit is due to the applicant's failure to furnish reasonably required information (§ 3005(e)).

The Administrator is also required to promulgate guidelines to assist States in the development of *State hazardous waste programs.* States are authorized to carry out their own programs unless the Administrator, within 90 days after receipt of an application, issues a notice that the program may not be authorized and within an additional 90 days, makes a finding that the State program is not equivalent to the federal program, or is not consistent with federal or State programs applicable in other States, *or* does not provide adequate enforcement of compliance with subtitle C requirements. A two-year interim authorization may be granted for State programs found to be substantially equivalent to the federal program. Once a State program is authorized, State action under the program has the same legal force and effect as action taken by the Administrator. Authorization must be withdrawn and the federal program reestablished whenever a State is not administering and enforcing its program in accordance with § 3006, and where appropriate corrective action is not taken within 90 days of notification (§ 3006).

Any records, reports, or information relating to a hazardous waste, obtained from any person under § 3007(a), must be available to the public, subject to the protective provisions of 18 U.S.C. § 1905 (§ 3007(b)).

The Administrator may enforce the requirements of subtitle C in a variety of ways including: compliance orders, permit suspension and revocation orders, and criminal and civil enforcement actions (§§ 3008).

Once the Subtitle C regulations become effective, no State or political subdivision may continue to impose any inconsistent requirements which are less stringent than those authorized by subtitle C (§ 3009).

The § 3001 regulations take effect 6 months after promulgation (or revision). However, within 90 days after promulgation or revision of such regulations, all hazardous waste generators, transporters, or owners or operators of a treatment, storage, or disposal facility must file with the Administrator (or an authorized state), a notification stating the location and general description of the activity and the identified or listed hazardous wastes handled. No identified or listed hazardous waste may be transported, treated, stored, or disposed of unless such notification has been given (§ 3010).

Finally, the Administrator is authorized to make grants to States to assist in developing and implementing authorized hazardous waste programs. Such grants are to be made on the basis of regulations which take into account the extent of the hazardous waste problem in each State (§ 3011).

Subtitle F subjects federal facilities to the requirements of RCRA to the same extent as private facilities.

Subtitle G provides protection for "whistle-blowers"—employees who testify in or institute any proceeding under RCRA (§ 7001); authorizes citizen suits against the Administrator or any other person (§ 7002); empowers the Administrator to file suit to immediately restrain any solid waste handling activity which presents an imminent and substantial endangerment to health or the environment (§ 7003); authorizes any person to petition the Administrator for the promulgation, amendment, or repeal of any regulation under RCRA, with the Administrator required to respond within a "reasonable time" (§ 7004(a)); requires the Administrator and authorized States to provide for, encourage, and assist public participation in the development, etc. of any regulation, guideline, information or program under the Act, and requires the Administrator to develop minimum guidelines for public participation (§ 7004(b)); requires judicial challenges to rulemaking by the Administrator to be filed in the U.S. Court of Appeals for the District of Columbia within 90 days of promulgation (§ 7006); and sets forth miscellaneous other provisions.

As usual, public participation is permitted and encouraged in rulemaking proceedings under RCRA.

13. Safe Drinking Water Act, Act of Dec. 3, 1974, as amended, 88 Stat. 1660, 91 Stat. 139, 42 U.S.C. § 300f, et seq.

The Safe Drinking Water Act ("SDWA") was designed to regulate contaminant levels in public water systems used for drinking water and to protect underground sources of drinking water from contamination due to waste disposal activities.

Parts A and B of the Act require the EPA Administrator to establish primary and secondary drinking water regulations. The primary regulations must specify criteria and procedures for maintaining drinking water contaminants at levels which will avoid "any adverse effect on the health of persons." The secondary regulations must specify the maximum contaminant levels consistent with protecting "the public welfare" (e.g., to avoid undesirable odors and appearance, even if not a public health threat).

For purposes of the primary regulations, maximum contaminant levels must be set at a level at which "no known or anticipated adverse effects on the health of persons occur and which allow[s] an adequate margin of safety" (§§ 1412(b)(1)(B), 1412(b)(3)).

Prior to promulgating both primary and secondary regulations, the Administrator must provide notice (in the Federal Register) and opportunity for public comment (in writing) and public hearing (§ 1412(d)).

Qualifying States may be delegated primary enforcement responsibility under the SDWA for public water systems (§ 1414). States and political subdivisions remain free, however, to adopt and enforce drinking water controls more stringent than those required under the SDWA (§ 1414(e)). Where the Administrator finds that a State which has been delegated primary enforcement responsibility is in noncompliance with SDWA requirements, he may hold public hearings to gather information on ways to bring the system into compliance within the earliest feasible time and on means of affording the maximum feasible protection of the public health in the interim. Such hearings may be convened upon the petition of persons served by noncomplying public water systems, among others (§ 1414(f)).

Under specified, limited circumstances, variances and exemptions from national primary drinking water regulations may be granted on a case-by-case basis (§§ 1415, 1416).

Part C of the SDWA requires the Administrator to publish regulations for State underground injection control programs. These regulations must contain "minimum requirements for effective programs to prevent underground injection which endangers drinking water sources" (§ 1421(b)(1)), but must, to the extent feasible, avoid requirements which would "unnecessarily disrupt State underground injection control programs which are in effect and being enforced in a substantial number of States" (§ 1421(b)(3)(B)). For purposes of these provisions, "underground injection" means "the subsurface emplacement of fluids by well injection"—underground disposal of liquid wastes by discharge into deep wells (§ 1421(d)). Before any regulation under this Part may be established, there must be public notice, opportunity for public comment, and an opportunity for public hearing (§§ 1421(a)(2), 1421(b)(4), 1421(c)(2)).

Part D gives the Administrator the emergency power to take any necessary action to protect public health "upon receipt of information that a contaminant which is present in or is likely to enter a public water system may present an imminent and substantial endangerment to the health of persons ..." (§ 1431(a)). This applies only where "appropriate State and local authorities have not acted to protect the health of such persons" (§ 1431(a)). Although it may well prove difficult in most cases to demonstrate that a contaminant may imminently and substantially endanger human health, this is the only provision of the Act which allows EPA to take preventive measures to avoid drinking water contamination due to above-ground activities (e.g., landfill disposal of wastes).

Among the SDWA's remaining miscellaneous provisions is one authorizing private citizens to bring civil actions against any person alleged to be in violation of any requirement prescribed by or under the Act, and against the Administrator where he is alleged to have failed to perform any non-discretionary act or duty under the SDWA. As is usual for such citizen suit provisions, sixty days' advance notice of the citizen's intent to sue must be provided before a lawsuit can be initiated. This is designed to enable the prospective defendant to voluntarily mend the error of his ways before the courts become involved (§ 1449).

Challenges to various regulations and orders issued by the Administrator may, however, only be brought within 45 days of their issuance, and in the specified U.S. Court of Appeals (rather than in U.S. District Court, where most federal lawsuits begin) (§§ 1448(a), 1449(e)(2)).

14. Toxic Substances Control Act, Act of Oct. 11, 1976, 90 Stat. 2003, 15 U.S.C. § 2601, *et seq.* *Synopsis:*

The Toxic Substances Control Act ("TSCA") authorizes EPA to obtain data from industry on the production, use, and health and environmental effects of chemical substances and mixtures. If necessary, EPA may regulate the manufacture, processing, commercial distribution, use, and disposal of such chemicals and mixtures. Pesticides, tobacco, nuclear material, firearms and ammunition, food, food additives, drugs, and cosmetics are exempted from TSCA because they are currently regulated under other laws.

The Act gives EPA four principal tools for minimizing the toxic hazards of chemicals: (1) testing requirements; (2) premarket notification; (3) direct regulatory authority; and (4) record-keeping and reporting requirements.

EPA may, by regulation, require manufacturers or processors of potentially harmful chemicals to conduct tests (at their own expense) on the chemicals, but the need for such testing must first be established. A need may be shown where the EPA Administrator determines that (a) the chemical may present an unreasonable risk to health or the environment or there may be substantial human or environmental exposure to the chemical; *and* (b) there are insufficient data and experience for determining or predicting the health and environmental effects of the chemical; *and* (c) testing of the chemical is necessary to develop such data. Testing may be required to evaluate the characteristics of a chemical, such as persistence or acute toxicity, or to clarify its health and environmental effects, including its ability to cause cancer, mutations, birth defects, behavioral abnormalities, and to enhance the toxic effects of other chemicals. (§ 4).

Any person who intends to manufacture or process a new chemical, or an existing chemical for a significant new use, must give the Administrator 90 days' notice before manufacturing or processing the chemical. Notices submitted must include the name of the chemical, its chemical identity and molecular structure, proposed categories of use, an estimate of the amount to be manufactured, the byproducts resulting from the manufacture, processing, and disposal of the chemical, and any test data related to the health and environmental effects which the manufacturer has. The manufacturer must also do new tests, and submit the resulting data, if the testing of the chemical or members of its chemical class is required by a rule promulgated by the Administrator, or if the Administrator has included the chemical on a published list of new chemicals or classes of new chemicals which present or may present an unreasonable risk of injury to health or the environment if they are introduced into commerce. Chemicals are exempt from the premarket notification requirement if they are: (a) included in categories listed on the inventory of existing chemicals (which the Administrator is required to publish under § 8); (b) produced in small quantities solely for experimental or research and development purposes; (c) used for test marketing purposes; (d) determined by the Administrator not to prevent an unreasonable risk or determined by the Administrator to be (e) short-lived in the environment and to not give rise to human or environmental exposure.

Following premarket notification, the manufacturer may proceed to produce or process the chemicals involved after 90 days have passed, unless: (a) the Administrator, for "good cause" extends the 90 day review period for another 90 days; (b) the Administrator issues an order at least 45 days before the review period expires to prohibit or limit the manufacture, processing, commercial distribution, use, or disposal of a chemical pending acquisition of additional data (where the Administrator determines that there is inadequate information to evaluate the health and environmental effects of a new chemical); or (c) the Administrator issues an order prohibiting or limiting the manufacture of a chemical (where the Administrator finds that there is a reasonable basis to conclude that a new chemical presents or will present an unreasonable risk of injury to health or the environment). (§ 5).

The Administrator must, prohibit or limit, by regulation, the manufacturing, processing, commercial distribution, use, or disposal of a chemical substance or mixture if he finds that these activities, separately or in combination, present or will present an unreasonable risk of injury to health or the environment. Labelling may be required for a chemical or any article containing it. A manufacturer may be required to keep records of the manufacturing processes used and to conduct tests to assure compliance with any regulatory requirements. Further, a manufacturer may be required to give notice of any unreasonable risk presented by his chemical to those who purchase or may be exposed to it. A manufacturer may also be required to replace or repurchase a substance which presents an unreasonable risk. If a chemical contains a hazardous contaminant as the result of a certain manufacturing process, the Administrator may order the manufacturer to change his process and avoid such contamination. (§ 6).

In addition, TSCA specifically requires the Administrator to regulate polychlorinated biphenyls (PCB's), by issuing labelling and disposal regulations by July 1977, restricting the chemical's use to closed systems by January 1978, prohibiting all production by January 1979, and prohibiting its distribution in commerce by July 1979. (§ 6).

The law requires the Administrator to issue rules requiring manufacturers and processors of selected chemicals to report to EPA the name of each chemical, its identify, its proposed uses, estimates of production levels, description of byproducts, adverse health and environmental data, and such materials. The Secretary may require covered hazardous material transporters, etc. to prepare and submit to the Secretary a registration statement which includes a complete list of all hazardous materials handled and the location of each activity handling such hazardous materials. "Hazardous materials" for purposes of this Act are particular quantities and forms of material which the Secretary determines may pose an unreasonable risk to health and safety or property when transported in commerce. The Act requires the Secretary to issue regulations prohibiting the transportation of radioactive materials on any passenger-carrying aircraft in air commerce, unless the materials involved are used in research or medical diagnosis or treatment.

Appendix 2

EPA Regional Toxic Substances Coordinators

MR. PAUL HEFFERNAN
Toxic Substances Coordinator
EPA Region 1, Pesticide Branch
John F. Kennedy Federal Building
Boston, Massachusetts 02203
(617) 223-0585

MR. JOHN BROGARD
Toxic Substances Coordinator
EPA Region 2
26 Federal Plaza
New York, N.Y. 10007
(212) 264-2637

MR. EDWARD COHEN
Toxic Substances Coordinator
EPA Region 3, Pesticide Branch
Curtis Building
6th & Walnut Streets
Philadelphia, PA 19106
(215) 597-7668

MR. RALPH JENNINGS
Toxic Substances Coordinator
EPA Regiona 4, Pesticide Branch
345 Courtland Street, N.E.
Atlanta, Georgia 30308
(404) 881-3864

MR. KARL BREMER
Toxic Substances Coordinator
EPA Region 5, Pesticide Branch
230 South Dearborn Street
Room 1165
Chicago, Illinois 60604
((312) 353-2291

DR. NORMAN DYER
Chief, Pesticides & Hazardous
Materials
EPA Region 6, Pesticide Branch
First International Building
1201 Elm Street
Dallas, Texas 75207
(214) 767-2734

MR. LEO J. ALDERMAN
Toxic Substances Coordinator
EPA Region 7, Pesticide Branch
324 East 11th Street
Kansas City, Missouri 64106
(816) 374-3036

MR. STEVE FARROW
Toxic Substances Coordinator
EPA Region 8, Pesticide Branch
1860 Lincoln Street
Denver, Colorado 80295
(303) 837-3926

MR. JERRY GAVIN
Toxic Substances Coordinator
EPA Region 9, Pesticide Branch
215 Fremont Street
San Francisco, California 94105
(414) 974-7032

MR. JIM EVERTS
Toxic Substances Coordinator
EPA Region 10, Pesticide Branch
1200 6th Avenue
Seattle, Washington 98101
(206) 442-1090

Appendix 3

ENVIRONMENTAL LAWS
(Names and Acronyms)

Atomic Energy Act of 1954	AEC
Clean Air Act	CAA
Clean Water Act	CWA
Consumer Product Safety Act of 1972	CPSA
Federal Environmental Pesticide Control Act of 1972	FEPCA
Federal Insecticide, Fungicide and Rodenticide Act	FIFRA
Federal Water Pollution Control Act	FWPCA
Food, Drug and Cosmetic Act	FDCA
Marine Sanctuaries Act	MSA
National Environmental Policy Act	NEPA
Noise Control Act	NCA
Occupational Safety and Health Act	OSHA
Poison Prevention Act of 1970	PPA
Ports and Waterways Safety Act of 1972	PWSA
Resource Conservation & Recovery Act	RCRA
Safe Drinking Water Act	SDWA
Superfund	Superfund
Toxic Substances Control	TSCA
Transportation of Toxic and Hazardous Substances	TTHS
Used Oil Recycling Act of 1980	UORA

Appendix 4

SOME NATIONAL ENVIRONMENTAL AND CITIZEN GROUPS WITH SPECIAL EXPERTISE ON TOXIC SUBSTANCES

Center for Science in the Public Interest
1755 S St., NW
Washington, D.C. 20009
(202) 332-9110
Food, nutrition, health charities, chemicals and behavior

Citizens Clearinghouse for Hazardous Waste
Box 7097
Arlington, VA 22207
(703) 276-7070
Lois Gibbs, Director

Conference on Alternative State and Local Policies
200 Florida Ave., NW
Washington, D.C. 20009
(202) 387-7030
"Toxics Briefing Book" (1984)

Environmental Action Foundation
724 DuPont Circle Building
Washington, D.C. 20036
(202) 659-9681
Ken Silver, Toxics Specialist
Alicia Culver, Hazardous Waste Specialist

Clean Water Action Project
733 15th Street, NW
Washington, D.C.
(202) 638-1196
Research, advocacy on Clean Water Act, groundwater contamination. "National Toxics Campaign"

Environmental Policy Center
317 Pennsylvania Ave., SE
Washington, D.C. 20003
(202) 547-5330
Toxics in groundwater, pesticides

Environmentalists for Full Employment
1536 16th St., NW
Washington, D.C. 20036
(202) 347-5590

Health Research Group
200 P St., NW
Washington, D.C. 20036
(202) 872-0320
OSHA, drugs

Natural Resources Defense Council
1725 Eye St., NW
Washington, D.C. 20006
(202) 223-8210
Research, litigation and lobbying

National Coalition Against the Misuse of Pesticides
530 7th St., SE
Washington, D.C. 20003
(202) 543-4312
FIFRAct, reproductive hazards, alternatives to pesticide use

Sierra Club
530 Bush Street
San Francisco, CA 94108
(415) 981-8634

Trial Lawyers for Public Justice
2000 P St., NW
Washington, D.C. 20036
(202) 463-8600
Toxics torts cases

Environmental Defense Fund
1525 18th St., NW
Washington, D.C. 20036
(202) 387-3500
Research, litigation and lobbying

Environmental Law Institute
1346 Connecticut Ave., NW
Washington, D.C. 20036
(202) 452-9600
Toxics victim compensation

Urban Environment Conference
666 11th St., NW
Washington, D.C. 20001
(202) 797-0446
Education and organizing on workplace and environmental issues; minorities and toxics

Appendix 5

TELEPHONE DIRECTORY FOR ASSISTANCE WITH TOXIC SUBSTANCES AND HAZARDOUS WASTES

CHEMTREC	1-800-424-9300
CHLOREP	1-800-424-9300
*CONSUMER AFFAIRS OFFICE	1-800-552-9963
EMERGENCY SERVICES	1-800-552-3831
ENERGY HOTLINE	1-800-552-3831
*ENVIRONMENTAL PROTECTION AGENCY	1-800-424-9065
*HAZARDOUS WASTE HOTLINE IN VIRGINIA	1-800-552-2075
*HAZARDOUS WASTE VIOLATION	1-800-552-2075
OFFICE OF EMERGENCY AND ENERGY SERVICES	1-800-323-2300
PCB SPILLS	1-800-424-8802
*POISON CENTER (COLLECT)	1-804-786-9123
POLLUTION, TOXIC CHEMICAL AND OIL SPILLS NATIONAL RESPONSE CENTER	1-800-424-8802
*STATE POLICE	1-800-552-9965
TENNESSEE VALLEY AUTHORITY ACTION LINE	1-800-362-9250
RADIOACTIVE WASTE INFORMATION U.S. DEPARTMENT OF ENEGERY	1-800-368-2235
AIR POLLUTION CONTROL BOARD	1-804-786-7523
BUREAU OF SHELLFISH SANITATION	1-804-786-7937
BUREAU OF TOXIC SUBSTANCES INFORMATION	1-804-786-1763
CANCER ASSOCIATION	1-804-359-0208
CHAMBER OF COMMERCE	1-804-644-1607

CHESAPEAKE BAY COMPANY	1-804-786-4500
COAST GUARD	1-804-771-2510
CONSOLIDATED LABORATORIES DIVISION ENVIRONMENTAL SCIENCE	1-804-786-7746
DEPARTMENT OF POLICE LAW ENFORCEMENT MOTOR CARRIERS	1-804-323-2183
HAZARDS FISH KILLS/OIL SPILLS	1-804-257-0080
HAZARDOUS WASTE MANAGEMENT	1-804-228-5271
HEART ASSOCIATION	1-804-643-7391
INTERSTATE COMMERCE COMMISSION	1-804-771-2541
SOLID AND HAZARDOUS WASTE, DIVISION OF	1-804-225-2667
TRANSPORTATION AND SAFETY	1-804-257-6620
WATER CONTROL BOARD CENTRAL OFFICE	1-804-257-0056
OFFICE OF EMERGENCY AND ENERGY SERVICES	1-804-323-2897
FEDERAL REGISTER OFFICE'S "DIAL-A-REG" SERVICE	
WASHINGTON, D.C.	1-202-523-5022
CHICAGO, IL	1-312-663-0884
LOS ANGELES, CA	1-213-688-6924
ASSOCIATION OF AMERICAN RAILROADS BUREAU OF EXPLOSIVES	1-202-293-4048

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*Indicates numbers citizens may call. All other numbers should be used only by local authorities.

Suggested Local Telephone Roster for Assistance

COMMUNITY ASSISTANCE
- POLICE
- FIRE
- CIVIL DEFENSE
- EPA
- DEPARTMENT OF TRANSPORTATION
- PUBLIC WORKS
  - WATER SUPPLY
  - SANITATION
- RESCUE SQUAD
- AMBULANCE
- HOSPITALS
- UTILITIES
  - GAS
  - TELEPHONE
  - ELECTRIC

COMMUNITY OFFICIALS
    MAYOR
    CITY MANAGER
    COUNTY MANAGER

INDUSTRIES
    TRANSPORTERS
    CHEMICAL PRODUCERS/CONSUMERS

ACKNOWLEDGMENTS

This edited version was originally developed and checked by Susan Booth, a teacher in Hanover County, Virginia and Jane Carroll, a teacher in Henrico County, Virginia.

Appendix 6

HAZARDOUS MATERIALS RESPONSE AND LOCAL GOVERNMENT

BY: R.C. Dawson, Jr., Captain, Hazardous Incident Team, County of Henrico, Division of Fire

In recent years there has been an increase in the awareness of local government that they lack the expertise and equipment to handle even the simplest hazardous materials accident. Response was geared to the normal Fire Department response with the assistance of local police and rescue squads. There was very little training, virtually no pre-planning, and rarely any coordination before and during the incident. Consequently, many mistakes were made, incidents may have escalated and even injuries and deaths may have occurred due to this lack of the understanding which is necessary before approaching any hazardous materials incident.

Within the last few years, more and more local government officials along with Federal and State government officials began to realize that there was a level of responsibility that they were not capable of addressing. The every day fire service response was just not enough. It took more than the desire to do a good job. It took planning, training, and equipment that was above and beyond normal response which traditionally had been supplied by our local government.

What or who has been the driving force behind this awakening? It's hard to pinpoint one person or incident that is responsible for the new found interest that is showing up at the local, state, and federal level. Individual agencies have in the past had some knowledge of the problem, however, attitudes that prevail usually fall in three categories. First: It won't happen to us. This denial of the possibility is prevalent in rural areas where the likelihood of an incident is not as great as a metropolitan area. Many local officials just don't believe that the problem exist in their areas. Second: Well, we'll cross that bridge when we get to it. This attitude exist in many places where the feeling is that we can handle (hopefully) anything that comes down the road. This obviously is a very dangerous attitude and one which requires on-scene personnel at an incident to make critical decisions, spur-of-the-moment. The third attitude found has been that if something happens we'll call someone else. This may be a viable alternative to doing something yourself, however, in most cases, help is non-existent or at least some time away.

As more and more incidents occur and the media covers these with a growing level of expertise, many local and state officials have realized that enough has not been done to upgrade the level of response to hazardous materials incidents. Spur-of-the-moment decisions, improvising of equipment, correcting mistakes made in haste, all have led to a growing awareness that more must be done. We must make a genuine effort to improve our level of training, pre-planning, and response if we are to provide the best possible protection to our citizens.

Where to Begin:

I can speak for our program; however, after three years of teaching throughout Virginia and the United States, I feel that I can also address similar problems that may occur in other localities.

First, determine what the level of attitude is. Where do you fall in determining your response? Are you denying any problem? Are you "crossing the bridge" upon arrival or are you counting on someone else all the time? After much thought and study, many find that they are doing all three. (Think about your area). Next, after knowing where you are, you attempt to find out where you want to go. Do you intend to only offer the normal fire department response or do you want to offer your citizens more? Where does your desire lie in providing the best possible protection? Have you made every effort to provide property protection, and what about the environment? Are you doing all that you could? Could you offer more?

So the first two steps are easy. They don't cost you any money and they don't take very long to determine. Once you know where you are and where you want to be, the next step is selling local administrators on a program which is designed to include analysis of your problem, local pre-planning to determine where your potential exists, establishment of a training program geared toward providing the ability to stabilize an incident, establishment of a hazardous materials program to include a team to respond, equipment to work with, and a training program for team members.

Analysis of Your Problems:

Traditionally local government has taken care of local problems. This is most likely the approach that local government will take in hazardous materials response. A thorough assessment of local problems can begin with a look at what is obvious. Do you presently have a facility that has the potential for a hazardous materials incident? Do you have any major transportation problem? Are there storage or processing plants that present a hazardous material problem? Look then at the subtle areas. Are you capable of handling a minor hazardous material problem? Do you have any areas that requires special tactics, equipment, etc.? Record this information, contact State agencies that deal in hazardous materials or hazardous waste. See if they can provide you with information that you can use on the local level. All of this information can be used to justify material purchases, training, and establishment of your program. This information should be updated at least annually, if not more often.

Present Resources:

What are your capabilities now? Do you possess the ability to provide life saving techniques at a hazardous materials incident? Can you make valid decisions concerning product I.D., Emergency Response Actions, Stabilization, etc.? Do you have any special equipment to assist in handling a hazardous materials call? Do you know who to call if you need additional help or advice?

Developing a Program:

There are many publications designed to assist local government in planning a hazardous materials program. Most are geared towards assisting in the planning and handling stages. Additional information on setting up a response team may be obtained from local, state or federal offices of Emergency Response. Regardless of where the information is obtained, it is important that you adopt this information to your local needs. It is not necessary to reinvent the wheel; it is important, however, to realize that what is good for one locality may not be the desired plan for another. It is not only the Fire Service, but local rescue squads, police, highway, utilities, welfare, etc., that are involved. Many state and federal agencies are also involved during an incident and it is important that they be a part of your local plan.

In summary, much has been done in the field of hazardous materials response. Many local governments can and do offer a higher level of expertise than the normal response usually found; the problem is that most do not. It is important to recognize the problem and to do something about it. Hiding your head, denying the problem exists or thinking that someone else will come to your rescue is courting disaster. Hazardous Materials Programs require a commitment from everyone involved; a commitment to save life, protect property and to protect the environment through stabilization of the incident. This program can be as simple as advanced training and the ability to evacuate the area and deny entry or may be as complex as equipping and training a full blown response team. Regardless of your desires or needs, you should begin to do something now. The worst time to wish that you had done something is at 2 a.m. on some wind blown highway or worse yet in downtown USA during rush hour traffic.

For more information regarding Hazardous Materials Response Team programs, contact Captain R.C. Dawson, Jr., Henrico County Division of Fire, P.O. Box 27032, Richmond, Virginia 23273.

Appendix 7

FACT SHEET FOR MOOR-FITE CYLINDER SITE INCIDENT

HAMPTON, VIRGINIA

JUNE, 1983

- Approximately 4000 cylinders containing low and high pressure compressed gases and liquids were indiscriminately disposed on a vacant unsecured lot in a residential section of the City of Hampton, Virginia.
- According to Hampton Fire Department personnel several gas cylinders were venting their contents into the atmosphere as a result of the extreme high temperatures. (Average daily temperature 98° F).
- On June 16, 1983, the State of Virginia and the City of Hampton requested EPA assistance to assess threats to human health and the environment and to determine need for cylinder removal and disposal.
- The EPA on-scene coordinator arrived on scene at 1500 hours on June 16, 1983, performed a site assessment and determined that CERCLA funding was necessary to abate threats to human health posed by leaking cylinders. CERCLA expenditures to $250,000.00 were authorized by the Region III Regional Administrator by 2000 hours June 16, 1983.
- Between June 16 - 25, 1983, each cylinder was categorized by contents (24 different toxic and hazardous gases and liquids) segregated by chemical class and transported to a RCRA facility for interim storage until disposal could be arranged.
- During this coordinated response effort, a 1000 foot exclusion zone was created to protect the nearby population. Approximately 100 persons had to be evacuated during EPA cleanup efforts.
- Overall, this cleanup was the result of coordinated efforts of various Federal, state and local agencies who worked long hours to abate the threats posed by the deteriorating cylinders.
- On November 9, 1983, the owner of the cylinders was convicted of two felony counts by the City of Hampton for violation of fire code regulations.

From: Fire Chief Kenneth Lavoie
City of Hampton, Virginia

Appendix 8

Resource Personnel Relating to Toxic Substances

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Safety, Health & Environmental
Affairs Manager
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(Getting hazardous materials out
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Commonwealth Virginia Division of
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"Water Pollution Issue"

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Chester, Virginia 23831
Phone: 804/748-5100

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***Participant in Virginia Academy of Science Visiting Scientists Program.**

Appendix 9

A GUIDE FOR HAZARDOUS MATERIALS DISPOSAL

Much of the following material has been extracted from the work and reports of Mr. Timothy W. Cotman, Science Supervisor, Virginia Department of Education, James Monroe Building, Richmond, VA 23216, (804) 225-2652. He was instrumental in developing a statewide project to dispose of school chemicals.

Implications of EPA Hazardous Waste Regulations on Public School Programs

The disposal of unwanted chemicals by public school departments including science, art, industrial arts and others has become more important and necessary in recent years. EPA guidelines have placed public sanitary landfill operators on guard for any and all substances which might fit EPA's definitions of hazardous waste. Often the reservations of the operators are unfounded but due to the magnitude of the potential consequences of handling regulated hazardous waste they often refuse to accept substances out of ignorance of what is regulated and a lack of security in dealing with that of which they have little knowledge.

"Hazardous waste" is defined by the EPA as a substance on a compiled list and/or having such characteristics as ignitibility, reactivity, toxicity and corrosivity. Each of these characteristics has a specific criteria established by EPA which is to be applied to ascertain if the substance is in fact "hazardous waste". If a substance meets any one of the criteria, it is hazardous waste by definition.

Small Quantity Generator

Under current EPA and state regulations, schools qualify as "Small Quantity Generators" of hazardous waste. This is because schools

1. do not generate 1000* kg or more per month of hazardous waste
2. do not generate 1 kg or more per month of acute toxic waste by EPA listing
3. do not generate 100 kg or more of hazardous waste containing sludge or other mixture of waste products.

*to be reduced to 100 kg in August of 1985.

As a small quantity generator, schools are exempt from some EPA disposal regulations for all but those substances on the list of "acutely hazardous waste". Being a small quantity generator somewhat simplifies in principle if not in action, the disposal problem. It is not necessary for EPA notification or special handling permits to transport and dispose of hazardous waste, provided the waste is properly treated and no emergency situation exists. Among the avenues available for disposal of hazardous substances are:

Neutralization: If the substance can be made non-hazardous through chemical reaction such as neutralization, it may be treated as any non-hazardous material. It cannot be an acutely hazardous substance.

Municipal Disposal Facility: Disposal of small quantities of hazardous materials is permissible by EPA and the State with prior written approval from state and local authorities. However, this can only be accomplished with the cooperation of the municipal solid waste disposal authorities. Some local facilities have adopted an arbitrary policy of refusal.

Recycle: Some materials may be returned to the vendor or some other preparer for their value in repreparation.

Commercial Disposal: Commercial pickup and disposal is very expensive but it is a more viable alternative for a one-time solution.

Options for Disposing of Laboratory Chemicals

This basically results in two options for disposing of laboratory chemicals. The teacher or homeowner can handle the job or pay a commercial disposal service. Although suggestions, helpful hints and procedures are included, it is generally recommended that self-disposal tasks be critically evluated and a preference be given to commercial disposal. Once disposal has been completed, discrete ordering of new chemicals should be instituted.

Included below are disposal methods collected from the Virginia Department of Education, Science Division and modified from Flinn Scientific Inc., P. O. Box 231, 910 W. Wilson Street, Batavia, IL 60510 (312) 879-6900. The Flinn Chemical Catalog/Reference Manual is available to teachers. They also provide professional disposal if requested. Another source for help for the teacher is the State Bureau of Solid and Hazardous Waste. They will not attempt the disposal but may have some suggestions for assistance.

No one, Flinn, State Department of Education, or the authors can assume the liability for accidents or the procedures reported herein but everybody urges the proper personal safety equipment and environment be considered. Gloves, goggles and body protection may be needed. A hood, good ventilation or outdoor reactions may be necessary. The use of an isolated area, a working companion, micro practice runs and an emergency telephone would be advisable.

Some Chemical Disposal Contractors

This is a list of those contractors who are actively seeking work in Virginia. There may be others equally well qualified contractors who have not expressed a desire to engage in operations in Virginia at this time.

CECOS International
P. O. Box 619
Niagara Falls, NY 14302
(716) 284-7113
call collect

Fondessy Enterprises, Inc.
(ACE)
876 Otter Creek Road
Oregon, OH 43616
(419) 726-1521

O. H. Materials Co.
Suite 203
1735 Jefferson Davis Highway
Arlington, VA 22202
1-800-521-9540
(703) 521-5575

Triangle Resource Industries
P. O. Box 210
Route #1
Watlington Industrial Road
Reidsville, NC 27320
1-800-334-5953

Advanced Environmental Technology
  Corporation
Morris Plains, NJ 07950
(201) 539-7111

Ecoflo
5801 Arbor Road
P. O. Box 692
Tuxedo, MD 20781
(301) 773-9500

Ferguson Harbor Service, Inc.
P. O. Box 8153
Nashville, TN 37207
(615) 227-3395

Industrial Marine Service, Inc.
P. O. Box 1779
Norfolk, VA 23501
(804) 543-5718

Pollution Control Services, Inc.
8050 Seminole Mall
Suite 375
Seminole, FL 33542
(813) 391-9736

Emergency Special Services
P. O. Box 998
11930 Centre Street
Chester, VA 23831
(804) 748-9694

Resource Technology Services, Inc.
P. O. Box 3228
Suffolk, VA 23434
(804) 539-0005

Suggested Methods for On Site Chemical Disposal Treatment

METHOD I (Votatile Organic Solvents)

Benzene
Toluene
Carbontetrachloride
Aniline
Acetamide
Formaldehyde
Butanol
Pyrogallic acid

Absorb on sand or vermiculite and allow to evaporate or burn. Mixing with a flammable solvent may be necessary before attempting to burn.

METHOD II

Arsenic trioxide
Lead chloride
Lead acetate
Lead nitrate
Sodium nitrate
Cobaltous nitrate
Potassium iodide
Magnesium chloride
Barium chloride
Lead carbonate
Cadmium sulfate
Chromium (III) oxide
Cobalt nitrate
Potassium Oxalate
Strontium nitrate
*Silver nitrate
Cadmium chloride
Antimony oxide

Add the chemical to a large quantity of water, add sodium carbonate (about half the volume of the chemical solution), a saturated solution; allow to stand for 24 hours. Be sure solution is neutral before washing to sewage with large quantities of water.

*Silver compounds are very valuable; if they must be removed, contact your supplier concerning possible return for value.

METHOD III

Picric Acid

This material is EXTREMELY EXPLOSIVE. Energy release comparable to TNT. Solicit assistance from experts in handling explosive (local, state police).

METHOD IV

Mercury and Compounds

Mercury or compounds of mercury should not be released in the environment. Contact your supplier for information regarding return and/or recovery.

METHOD V

(Inorganic Acids)
Sulfuric Acid

Add the acid very slowly to a very large volume of sodium carbonate or calcium hydroxide solution until neutral and send to sewage.

METHOD VI

(Alkaline Metals)
Lithium
Sodium
Potassium

Cover with excess DRY sodium carbonate; mix with isopropanol or butanol; allow to stand for 24 hours; wash to sewage with large quantities of water. (Caution: This reaction produces hydrogen gas and should be performed with small amounts of the metal in an open area away from any source of spark.)

METHOD VII

(Oxidizing Agents)

Bromine
Sodium Chromate
Ammonium Chromate
Iodine
Potassium Chlorate
Sodium Chlorate
Chromic Acid
Potassium Permanganate
Potassium Chromate
Sodium Chromate
Ammonium Dichromate
Iodine Crystals

Reduce with hypo solution (sodium thiosulfate), allow several hours for complete reaction, neutralize and wash to sewer with large quantities of water.

METHOD VIII

Chromium
Cobalt
Antimony
Magnesium
Cadmium

Most nonalkali metals may be removed directly to solid waste disposal or salvaged for value. Powdered magnesium may be mixed lightly with sand, exposed to oxygen in an uninhabited area and allowed to burn to completion.

METHOD IX

(Organic acids)
Tannic Acid
Phenol

Treat with sodium carbonate, neutralize and send to sewage with large quantities of water.

METHOD X

Phosphorus Pentoxide

Mix sodium carbonate and calcium hydroxide in equal proportions; add mixture to P_2O_5 from behind shielding; spray with water and neutralize before sending to drain with large quantities of water.

METHOD XI

Phosphorus - red

Take to landfill under water and allow the water to evaporate (or spill), material should auto-ignite, allow to burn to completion.

METHOD XII

Benzoyl Peroxide

Add to a large quantity of sodium hydroxide solution (20%). Allow 24 hour reaction time and wash to sewage with large quantity of water.

METHOD XIII

Sodium Sulfide - Potassium sulfide

Add sulfide to 50% solution of ferric chloride; add sodium carbonate to neutralize; wash to sewage with large quantity of water.

METHOD XIV

Aluminum Chloride

Mix with sodium bicarbonate, spray with concentrated ammonium hydroxide, add ice water. Neutralize and wash to sewage with a large amount of water.

CAUTION: Wear protective clothing; goggles or face shield, gloves and apron, while performing any of these procedures.

References

Muir, G.D., Hazard in the Chemical Inventory, London, Available from: Lab Safety Supply, P.O. Box 1363, Jonesville, WI 53545 (603-745-2345).

Chemical Catalog Reference Manual, Flinn Scientific, Inc., P.O. Box 231, 910 W. Wilson Street, Batavia, IL 60510 (312-879-7900).

Handbook of Laboratory Safety, CRC Press, Inc., Boca Raton, FL. Available from: Lab Safety Supply, P.O. Box 1363, Jonesville, WI 53545 (608-754-2345).

Sax, N.I., Danagerous Properties of Industrial Materials, Van Nostrom Reinhold Company, NY.

Recommended Substitution of Relatively Non-Toxic Chemicals In Place of Chemicals With High Potential of Toxicity

TOXIC CHEMICALS	RELATIVELY NON-TOXIC SUBSTITUTES
Chloroform	1,1,1-Trichloroethane
Carbon tetrachloride	Tetrachloroethylene Trichlorotrifluoroethane
1,4-Dioxane	Tetrahydrofuran 1,2-Dimethoxyethane
Benzene	Cyclohexane, Toluene
Xylene	Toluene
Isobutanol	n-Butanol
Lead Chromate	Copper carbonate
Hydrogen sulfide	Thioacetamide
Napthalene	p-Nitrotoluene
p-Dichlorobenzene	p-Nitrotoluene
Potassium	Calcium
Dichromate/Sulfuric acid mixture	Ordinary detergents
Trisodium phosphate	Ordinary detergents
Alcoholic Potassium hydroxide	Ordinary detergents

GLOSSARY

SECTION
V

The Dilemma Of Toxic Materials

BEST COPY AVAILABLE

GLOSSARY

Vocabulary related to toxic and hazardous substances

The following is a vocabulary list with definitions as they generally apply to the study of toxic and hazardous substances. Technical definitions have been verified, where appropriate, using The Chambers Dictionary of Science and Technology (T.C. Collocott, ed.) and other sources (see references). Other terms, phrases, and abbreviations are included. All terms were presented at The Toxic and Hazardous Substances Workshops held the Spring and Summer of 1983 and the Summer of 1984 at Virginia Commonwealth University, Richmond, VA. The definitions included are intended to help science and social studies teachers and their students as they study this broad topic.

ACID RAIN
Rain that has a pH lower than normal rainfall (pH=5.6). Normal rain is acidic (pH greater than 7), acid rain has a pH less than 5.6.

ACTION LEVEL
Level of toxic or hazardous substance below which there is considered to be little problem. When the "action level" is reached, the appropriate agency takes action to correct the problem.

ACUTE
Short term effect of a substance, usually at high concentrations, on organisms.

ACUTE DOSE TESTING
The testing of a substance to determine its LD50.

AERATION
The exposure of a substance to air.

ADSORPTION
The retention of a substance on the surface instead of being absorbed.

ALKALI
Soluble salts that, in solution, have a pH greater than 7 and are used to neutralize acids.

AQUIFER
Porous layer of soil or rock that contains water.

BEST COPY AVAILABLE

ASBESTOS

Fibrous mineral mined to be used primarily in various types of insulation. Classified as a carcinogen.

ASBESTOSIS

Scarring of the lung due to exposure to asbestos.

BAFFLE WALL

A partition in a tanker that separates one section of the material being transported from another section. It also serves to help reduce the friction that results from the fluid motion of a liquid.

BEST AVAILABLE TECHNOLOGY

Any process that is the most efficient, safe, cost effective, etc., and available to use.

BIOACCUMULATION (BIOCONCENTRATION)

The process of a substance passing up the food chain. This results in a higher concentration of the material in the higher organisms of the chain.

BIODEGRADABLE

The ability of a substance to be broken down by natural agents such as bacteria.

BIOLOGICAL HALF-LIFE

The time required for one-half of a chemical to be excreted from an organism.

BIOLOGICAL TREATMENT

The breakdown of wastes by biological means (usually bacteria).

BODY BURDEN

Amount of substance per body weight of an organism. It is evidence that the chemical is in the blood or fat of the organism.

BONDED

The cementing together of fibers to prevent their escaping into the air.

BY-PRODUCT

All material other than the major product of an industrial process.

CAA

Clean Air Act.

CAPACITOR

Device used to insure uniform electric current.

CARCINOGEN

Cancer causing agent.

CARDIOVASCULAR DISEASE

Any disease whose major effect is on the heart and circulatory system.

CAUSTIC
The ability of a substance to destroy by chemical action.

CDC
Centers for Disease Control located in Atlanta, GA.

CELL
A section of a landfill.

CHEMOPHOBIA
Fear of chemicals.

CHRONIC
Long-term effect of a substance, usually at low concentrations, on organisms.

CHRONIC DOSE TESTING
The testing of a substance to determine the effects of repeated exposure to small amounts of the substance over a long period of time.

COMMON LAW
Judge made law. Law derived from judicial processes in the court system.

CONCENTRATION
The amount of solute per volume of solvent, mg/ml, g/l.

CONTAMINANT
Any substance not desired in the final product.

COST/BENEFIT
Analysis of the cost of a process, item, etc., and the economic benefit (gain or loss) that results from its use or implementation.

CPSC
Consumer Product Safety Commission, Washington, D.C., 1-800-638-2772.

CRADLE TO GRAVE
Method of tracking a waste from its formation to its eventual removal, disposal, and/or treatment.

CYANIDE
Extremely poisonous compound of the cyanogen radical (CN) and a metallic element or radical (for example: potassium cyanide - KCN).

CYANOSIS
A blue coloring of the skin due to lack of oxygen in the blood.

DDT
Dichlorodiphenyltrichloroethane- an insecticide capable of bioconcentration.

DECONTAMINATE
To remove or break down the unwanted material so that it cannot do any harm or damage.

DEEP WELL INJECTION

A method of disposing of liquid hazardous wastes by injecting or forcing them deep into the ground.

DELANEY CLAUSE

Provision of the 1958 Food Additive Act that states that any cancer causing agent may not be used as an additive to any foodstuffs.

DISTILLATION

Purification process of a substance through heating and cooling.

DIELDRIN

A pesticide that is a cancer-causing agent that reacts with lipids/fats in the body.

DILUTE

To make a solution less concentrated.

DIOXIN

A general class of organic compounds associated with pesticides as a contaminant in herbicides. The popular compound "dioxin" is really 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD).

DNA

Deoxyribonucleic Acid; the genetic material of a cell.

DOT

Department of Transportation

ECOLOGY

Study of the relationship between a plant or animal and its surroundings.

ECONOMIC RETURN

Amount of profit or loss based on amount of investment.

EDF

Environmental Defense Fund, a national environmental interest group.

EFFLUENT

Discharge, usually a mixture of wastes in water, from an industrial process. This waste may be treated or untreated.

EMINENT DOMAIN

The process allowing a government the right to condemn and seize private property to use for the public good.

ENCAPSULATION

The spraying of a non-toxic coating which either soaks into material and binds it together or covers it with a plastic-like shield.

ENCLOSURE
The making of an air tight barrier around some material, thus preventing the materials from getting into the air.

ENVIRONMENTAL IMPACT STATEMENT
Evidence of an extensive survey of the effects of proposed construction or changes to the environment of an area.

EPA
Environmental Protection Agency, a U.S. Governmental Agency based in Washington, D.C.

EPIDEMIOLOGY
The study of disease trends in a population.

EVIDENCE
Legal proof related to an incident, such as items or testimony.

FDA
Food and Drug Administration, a U.S. Governmental Agency based in Washington, D.C.

FLASH POINT
The temperature at which a substance can have sufficient heat to ignite, but not to support a sustained combustion.

FLYASH
Fine, solid waste from the combustion of coal.

FRIABLE
The ability to break into small pieces and therefore be dispersable in air.

GENERATOR
Source of wastes.

GROUNDWATER
Water located in porous layers underground.

HAZARDOUS
Having dangerous properties.

HEAVY METAL
A metal having a specific gravity of approximately 5.0 or higher. Most such metals including Pb, Hg, Cr, and Ni are quite toxic.

HEPATOXIN
Toxic to the liver.

HYDROLYSIS
The reaction of a substance with water.

IGNITION TEMPERATURE
The temperature at which a substance has sufficient heat to ignite and sustain combustion

INCINERATION
Burning hazardous waste at high temperatures with subsequent destruction or reduction in volume.

INDUSTRIAL HYGIENE
The broad study of occupational health and safety. This study and planning incorporates general safety, toxicology, engineering, etc.

INFECTIVE TOXIC WASTE
Disease-carrying (pathogenic) toxic waste. An example would be tapeworms in sewage sludge.

INGEST
To eat or swallow.

INORGANIC
General reference to compounds that do not contain carbon atoms.

INSECTICIDES
A substance used to control insects.

INTERIM STATUS
The position of a manufacturer while waiting for a permit to store its waste for a period greater than 90 days.

JOINTLY LIABLE
Two or more persons would share legal responsibility for negligence.

KEPONE
A pesticide that received much attention due to extensive contamination of the James River. Decachloro-octahydro-1,3,4,-metheno-2H-cyclobuta(cd)-pentalen-2-one.

KYANITE
A fibrous mineral used to make a heat resistant ceramic that may be used in making spark plugs, lining for furnaces in steel mills, etc.

LAGTIME
The time between the initial exposure to a toxic substance and the appearance of the symptoms.

LANDFILL
A place where wastes are deposited and covered with earth.

LAND TREATMENT
A method of disposing of hazardous wastes by mixing them in the soil and then spreading water over the soil;the biological activity of the soil breaks down the wastes.

LC50

Lethal concentration. The concentration at which 50% of the animals tested die from the inhalation of the substance.

LD50 (MEDIAN LETHAL DOSE)

Lethal dose. It is the dosage at which 50% of the animals tested die when given an injection of a substance.

LEACHING

Dissolving and movement of substance by water or other liquid.

LEACHATE

The mixture, usually in water, of compounds removed by leaching.

LETHAL

Causing death.

LOVE CANAL

A neighborhood near Niagara Falls, New York, which was built on a chemical dump site. It was declared a national emergency area by President Carter in 1978 because of chemical contamination.

LTL

Less than a Truck Load.

MANIFEST

Hazardous waste tracking system. The paperwork associated with the production, transportation,and disposal of hazardous wastes.

MEDIAN LETHAL DOSE (LD50)

(See LD50).

MERCURY (Hg)

A liquid metal that easily vaporizes and can be toxic in the liquid or gaseous state.

MESOTHELIOMA

Form of cancer resulting from exposure to asbestos. The fibers form tumors in the lung or abdominal lining.

MSHA

Mine Safety And Health Administration.

MONITORING SYSTEM

A system of testing whether hazardous substances are escaping into the environment.

MUCK POND

A containment area where semi-solid wastes from some industrial processes are stored.

MUTAGEN

A substance that can alter DNA in a cell and produce mutations.

NARCOSIS

General depression of the central nervous system.

NCI

National Cancer Institute, a U.S. Governmental Agency located in Rockville, MD.

NEPHROTOXIN

Toxic or poisonous to the kidneys.

NEUROTOXIN

Toxic or poisonous to the central nervous system.

NEUTRALIZATION

The combination of acids and bases to produce salts.

NIOSH

National Institute for Occupational Safety and Health.

NON-FRIABLE

A usually friable substance involved in a tight-binding matrix.

ORGANIC

Compounds that contain carbon atoms.

ORPHAN SITE

Area of dumping that has been abandoned. No one accepts the site as a responsibility.

OSHA

Occupational Safety and Health Administration.

PATHOGEN

Any disease producing micro-organisms.

PBB

Polybrominated Biphenyls.

PCB

Polychlorinated Biphenyls.

PENTABORANE

A chemical substance that is a boron hydride that permanently affects the central nervous system if absorbed by the body.

PESTICIDE

A chemical or other agent that will destroy a pest or protect something from a pest.

PERMEABLE

The ability of a rock strata to permit the passage of a fluid through the pores or crevices.

pH

The hydrogen ion concentration of a substance which determines its acidity or basicity. pH = -log(H+). (H+)= Hydrogen ion concentration. pH = 7 Neutral, pH less than 7 Acidic, pH greater than 7 Basic

PHOTOLYSIS

The decomposition (breakdown) of a compound due to a reaction (usually absorption) with light.

PHYTOTOXICITY

Injury to plant life caused by a chemical or other agent.

POLLUTION

Any undesired substance, natural or man-made, that contaminates the environment .

POROUS

The ability of a substance to hold or allow liquid to pass though it.

PPM

Parts Per Million.

PPB

Parts Per Billion. Examples are: 1 inch in 16,000 miles, 1 second in 32 years, 1 cent in $10,000,000.00, 4 drops in an Olympic-sized swimming pool.

PSYCHOGENIC

Mental in origin.

PYROLYSIS

The burning of a substance.

RADIOACTIVE

A substance that has undergone spontaneous disintegration of its atomic nucleus, accompanied by the emission of ionizing radiation.

RCRA

Resource Conservation and Recovery Act. An EPA program dealing with disposal of toxic and hazardous wastes.

RECYCLE

Using a waste as a resource for another process.

RIP-RAP

The covering of contaminated soil with filter fabric, sand and rocks to decrease erosion and still allow the passage of ground water.

RISK

Knowledge of danger associated with an action or task. "Calculated Risk" concerns weighing dangers versus benefits to be gained.

ROAD-RIGHTS

The authority of a transporter to use certain roads/highways.

SCRUBBING

Water spray used to clean ("scrub") solid particles out of gas.

SECURE LANDFILL

A disposal area with a liner (clay, synthetic, or both) into which wastes are deposited and covered to avoid contact with surface water and groundwater.

SHORT-TERM PESTICIDE

A pesticide which breaks down almost immediately after application into non-toxic by-products.

SLUDGE

A deposit of sediments. Such sediments are often the processed by-product of sewage plants.

SOLVENT

A liquid such as water or alcohol in which a substance will dissolve and form a solution.

SPECIFICATION TANKER

A tanker that is built according to Federal guidelines or regulations and is authorized to transport certain hazardous materials.

SPECIFIC GRAVITY

A comparison of the density of a substance with the density of an equal volume of water.

SPIROMETRY

A mechanical method of determining the air volume of an individual. This is used as an indicator of lung damage which could be caused by cancer, asbestosis, mesothelioma, black lung, etc.

STATUTORY LAW

Legislative law serving the purpose of "on-the-books" regulation.

SUB-CHRONIC DOSE TESTING

The testing of a pesticide or substance to determine its MTD (Maximum Tolerated Dose) at which illness and weight loss, but not death, may be produced.

SUPERFUND

Tax on chemical producers with governmental assistance providing some of the monies being used to clean up chemical dump sites.

SYNERGISM

The effects of two chemicals is not the result of a simple addition of the two separate effects, but the effects of each are multiplied.

TAILINGS
Residue or scraps of the mining process.

TERATOGEN
A substance that causes injury or malformation to the fetus with no harm to the mother.

THIOSULFATE
A form of thiosulfuric acid that may be used for in situ (in place) stabilization.

TOLLING OPERATION
A major producer licensing product production to a small outside operator.

TOSCA (TSCA)
Toxic Substances Control Act.

Toxic
Presenting some form of danger to the health and functioning of organisms.

TOXICOLOGY
Study of the adverse effect ("poisoning") of chemicals on biological systems.

TRANSFORMER
A device used to regulate electric current in lines. Currents can be reduced or boosted as needed by specific types of transformers. Older models may have oil containing PCB.

TSD
Treatment, Storage, and Disposal Facility

TSCA
Toxic Substance Control Act.

WASTE
Material discarded or served its intended purpose.

WASTE ABATEMENT
Reducing or stopping the production of toxic wastes.

WORKMANS' COMPENSATION
Insurance, paid by employers, for employees who are injured on the job.

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SECTION VI

The Dilemma Of Toxic Materials

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